CITY COUNCIL
CITY AND COUNTY OF HONOLULU
HONOLULU, HAWAII

No. 17-266

RESOLUTION

APPROVING THE RECOVERY PLAN FOR THE HONOLULU RAIL TRANSIT PROJECT SUBMITTED TO THE FEDERAL TRANSIT ADMINISTRATION ON SEPTEMBER 15, 2017.

WHEREAS, Chapter 1, Article 8, Revised Ordinances of Honolulu 1990, as amended, requires that any intergovernmental agreement or amendment thereto concerning the Honolulu High Capacity Transit Corridor Project ("Rail Project") that places an obligation on the City and County of Honolulu ("City") receive the prior consent and approval of the Council of the City (the "City Council"); and

WHEREAS, on December 1, 2016, the Honolulu Authority for Rapid Transportation ("HART") submitted the Draft Update of the Financial Plan for the Full Funding Grant Agreement to the Federal Transit Administration ("FTA"), which stated that the estimated Rail Project cost would result in a shortfall of approximately $2.847 billion; and

WHEREAS, on April 28, 2017, HART submitted the Recovery Plan containing a revised financial plan in Section 6 of the Recovery Plan to the FTA; and

WHEREAS, by letter dated July 24, 2017, the FTA indicated that the Recovery Plan dated April 28, 2017, was inadequate and did not include a revised financial plan with funding sources sufficient to cover HART's estimated total Rail Project cost; and

WHEREAS, the FTA requested that HART provide a revised financial plan by September 15, 2017, that reflected funding sources sufficient to deliver the total Rail Project; and

WHEREAS, on September 15, 2017, HART submitted a Recovery Plan to the FTA, attached hereto as Exhibit "A" and by reference made a part of this Resolution (the "Recovery Plan"), including a revised financial plan (the "updated Financial Plan") with funding sources sufficient to cover HART's estimated total Rail Project cost, but subject to the City Council's approval; and

WHEREAS, the updated Financial Plan includes a City subsidy for HART's administrative, marketing and operating costs in the amount of $160 million and the issuance by the City of fixed-rate, variable-rate and tax exempt commercial paper bonds to partially finance the Rail Project; and

WHEREAS, if accepted by the FTA, the updated Financial Plan will be made a part of the Full Funding Grant Agreement; now, therefore

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RESOLUTION

BE IT RESOLVED by the Council of the City and County of Honolulu that the Council approves the Recovery Plan, including the updated Financial Plan, substantially in the form attached hereto as Exhibit "A" and dated September 15, 2017; and

BE IT FURTHER RESOLVED that HART is authorized to execute other documents the FTA may require in connection with or related to the Recovery Plan, so long as such documents do not incur additional obligations on the part of the City; and

BE IT FINALLY RESOLVED that the Clerk be, and is hereby directed to, transmit a copy of this Resolution to the Mayor, the Executive Director and Chief Executive Officer of HART, the FTA, and to other agencies as may be necessary.

INTRODUCED BY:

(br)

DATE OF INTRODUCTION:

SEP 26 2017
Honolulu, Hawaii

Councilmembers

EXHIBIT A

RECOVERY PLAN

SEPTEMBER 15, 2017

HONOLULU AUTHORITY for RAPID TRANSPORTATION

9/15/17

Andrew S. Robbins
HART Executive Director and
Chief Executive Officer

Date

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Appendices

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Acronyms

AGS	Airport Section Guideway and Station Group
AIS	Archaeological Inventory Survey
APTA	American Public Transportation Association
BLS	United States Bureau of Labor Statistics
BOE	Basis of Estimate
CAM	Critical Access Milestone
CAGR	Compounded Annual Growth Rate
CCGS	City Center Section Guideway and Station Group
CMS	Contract Management System
CPI-U	Consumer Price Index All Urban Consumers
CPP	Contract Packaging Plan
CSC	Core Systems Contractor
DB	Design-Build
DBB	Design-Bid-Build
DBOM	Design-Bid-Operate-Maintain
DTS	City and County of Honolulu, Department of Transportation Services
EAC	Estimate at Completion
EIS	Environmental Impact Statement
FEIS	Final Environmental Impact Statement
FFGA	Full Funding Grant Agreement
FHSG	Farrington Highway Station Group
FRR	Farebox Recovery Ratio
FTA	Federal Transit Administration
FY	Fiscal Year
GET	State of Hawaii General Excise and Use Tax
GO	General Obligation
HART	Honolulu Authority for Rapid Transportation
HDOT	State of Hawaii Department of Transportation
HECO	Hawaiian Electric Company, Inc.
HRTP	Honolulu Rail Transit Project
ICE	Independent Cost Estimate
KHG	Kamehameha Highway Guideway
KHSG	Kamehameha Highway Station Group
kV	Kilovolt

LCC	Leeward Community College
LPA	Locally Preferred Alternative
MOS	Minimum Operable Segment
MPIS	Master Project Integrated Schedule
MSF	Maintenance and Storage Facility
MTA	Metropolitan Transportation Authority
NEPA	National Environmental Protection Act
NTP	Notice to Proceed
O&M	Operations and Maintenance
OahuMPO	Oahu Metropolitan Planning Organization
OTS	Oahu Transit Services, Inc.
P-3	Public-Private Partnership
PHGT	Pearl Highlands Parking Garage and Transit Center
PMOC	Project Management Oversight Contractor
PMP	Project Management Plan
R&O	Risks and Opportunities
RFP	Request for Proposals
ROC	Rail Operations Center
ROD	Record of Decision
ROW	Right-of-Way
RSD	Revenue Service Date
RVH	Revenue Vehicle Hour
SB4	Senate Bill 4
SCC	Standard Cost Category
SEIS	Supplemental Environmental Impact Statement
SUE	Subsurface Utility Engineering
TAT	Transient Accommodation Tax
TCE	Temporary Construction Easement
TCP	Traditional Cultural Property
TDFM	Travel Demand Forecasting Model
TECP	Tax-Exempt Commercial Paper
TIA	Time Impact Analysis
TOD	Transit-Oriented Development
UH	University of Hawaii
USDOT	United States Department of Transportation
WBS	Work Breakdown Structure

WMATA	Washington Metropolitan Area Transit Authority
WOSG	West Oahu Station Group
WOFH	West Oahu/Farrington Highway Guideway
YOE	Year of Expenditure

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1 Executive Summary

1.1 Introduction

On December 19, 2012, the Federal Transit Administration (FTA) and the City and County of Honolulu (City) formalized a partnership by signing a Full Funding Grant Agreement (FFGA) for the Honolulu Rail Transit Project (HRTP or Project). The Honolulu Authority for Rapid Transportation (HART) is the semi-autonomous public transit authority responsible for the planning, construction, and expansion of the fixed guideway transit system for the Project. The HRTP is a 20.1-mile fixed guideway rail system with 21 stations extending from East Kapolei to Ala Moana Center. By 2030, nearly 70% of Oahu's population and more than 80% of the island's jobs will be located along the 20.1-mile rail corridor, with stations at key commuter and visitor destinations such as the Honolulu International Airport, Joint Base Pearl Harbor-Hickam, and downtown Honolulu. The initial State of Hawaii General Excise and Use Tax (GET) surcharge was intended to provide a 70% local share (30% federal share), which is one of the highest local share overmatches in the FTA New Starts Program.

The Project has faced numerous challenges since its inception that have resulted in cost increases and schedule delays. Project planning and cost estimates were developed in the midst of a recession and were hampered by a number of events that were beyond the anticipation of the original parties. At the same time, there were well-intended decisions to award various Project construction contracts to stimulate local job creation prior to completing all third-party agreements, contractor interface requirements and, in some cases, applicable designs. Consequently, these early contract awards had subsequent cost and schedule impacts that have contributed to the need for this Recovery Plan.

In addition, delays associated with Notice to Proceed (NTP), the Archaeological Inventory Study (AIS), and Traditional Cultural Properties (TCPs)—which suspended construction activities on the West Oahu/Farrington Highway Guideway (WOFH), Kamehameha Highway Guideway (KHG), and Maintenance and Storage Facility (MSF) contracts—had a large impact on project costs totaling $172 million, including escalation. Moreover, the lawsuit delays pushed construction activities into the recovery years following the recession, which had a cascading impact on schedule and, in turn, had even further cost impacts on the Project. Finally, an equally harmful and even longer-term cost impact, also beyond the control of the Project sponsor, is the fact that Honolulu became the most expensive city for construction in the United States for the years 2012 through 2016, according to the Rider Levett Bucknall National Construction Cost Index. While the execution of some early contracts in hindsight was unfortunate and had substantive cost impacts, there were also many cost impacts that could not have been anticipated.

Despite these challenges, HART, the City, and the Mayor's Office are committed to construct and deliver the Project as described in the FFGA. With this update to the Recovery Plan—which now includes a Financial Plan that is predicated on additional local revenues generated by Act 1 Relating to Government of the Twenty-Ninth Legislature, 2017, First Special Session (Act 1), which was enacted into law with the signature of Governor David Ige on September 5, 2017—HART is able to confirm that it has the resources to complete the HRTP as described in the FFGA—20.1 miles with 21 stations. Subsequent to the State action, the City Council adopted Ordinance 17-48 in support of the funding language in the bill, and the Mayor signed the same on September 7, 2017.

In addition, this Recovery Plan demonstrates that HART has diligently developed and put in place management structures, controls, and procedures that are as important to the recovery of this Project as are the needed additional funds.

This updated Recovery Plan further details the organization's core competencies and the development and implementation of critical project management, risk management, and cost and schedule controls that are essential to the recovery of this Project. HART is also proactively evaluating additional opportunities to reduce project cost and revising future contract language and requirements based on knowledge gained from having prepared, awarded, and managed prior alternative delivery transit contracts. The recent cancellation of the design contract for the final City Center segment of the Project due to a conflict of interest created by the merger of the design firm and a construction firm on the Middle Street segment of the Project facilitates the opportunity to structure that contract procurement to be cost effective and provide schedule certainty, and HART will consider all options including a Design-Build-Finance solicitation for the City Center guideway and stations that includes a possible Public-Private Partnership (P-3) element. Seeking P-3 financing as a part of a Design-Build-Finance solicitation could potentially reduce the public funding elements of the City Center contract as well as potentially transfer schedule and cost risk. Regardless of the bid process used for the City Center segment, cost and schedule controls will be increasingly important as the Project moves into Honolulu's dense urban core. The delay in the procurement of the City Center Section Guideway and Station Group (CCGS) contract has enabled HART to advance the utilities design as Design-Bid-Build documents minimizing the risks associated with utilities relocations and approvals.

1.2 Management Capacity and Capabilities

HART is confident that it can successfully deliver the Project with its experienced key personnel and core competencies. As detailed in Section 3.2.3 of this updated Recovery Plan, HART now has in place a core group of individuals who have the qualifications and experience to complete a major transportation project of this scope and complexity.
A continuing challenge for the Project has been hiring and maintaining experienced rail transit and construction managers. Given the fact that this is Honolulu's first rail transit construction project, its remote location 2,400 miles from the U.S. mainland, and the fact that it is one of the most expensive cities in the United States in which to live, hiring and

retaining experienced personnel has been a challenge. Section 3, "Management Capacity and Capabilities," outlines the steps HART has been taking to immediately address open senior management positions, and it describes longer-term efforts to mentor Hawaii-based personnel toward the skills and experience needed to assume leadership roles.

On September 5, 2017, Andrew S. Robbins became HART's new Executive Director and CEO. Mr. Robbins brings more than 37 years of rail transit experience to the Project along with a particular expertise with driverless public transit systems that operate elsewhere in the world. These skills and experience will be most helpful as HART commissions the first high-tech driverless train to be used on a city-wide transit system in the United States. Mr. Robbins will build upon the momentum established by HART Interim Executive Director and CEO Krishniah Murthy with respect to streamlined project delivery and efficient cost and containment controls.

HART has made great strides in developing a robust Project Controls capability that is an integral part of the Project delivery team, which had been noted as a specific area of concern by the FTA and the recent American Public Transportation Association (APTA) Peer Review. Project Controls has worked to re-baseline the Project schedule and budget and to develop a trend analysis for the early detection of cost overruns, schedule impacts, and project risk. Development and implementation of robust tools such as the Master Project Integrated Schedule (MPIS) has resulted in increased communication and coordination with Project stakeholders and stronger management of the Project at all levels.

In 2016, HART increased its focus on risk by implementing a formal risk modeling program that uses a rigorous bottom-up analysis and cross-departmental input to establish confidence in Project cost and schedule. The Risk Management Committee, established earlier this year, meets monthly to review the health of the Project as it relates to contingency drawdown curves and risk exposure. These discussions enable executive managers to more closely monitor Project risk items and allow risk owners to apply mitigations to prevent cost and schedule impacts.

The HART Operations and Maintenance (O&M) Division is dedicated to containing costs and maintaining scheduled system openings by ensuring a seamless transition from capital construction and commissioning to passenger service. The HART O&M Division meets regularly with the City Department of Transportation Services (DTS) leadership to actively work on a roadmap to revenue service. During the current phase of the Project, the HART O&M Division remains focused on organizational development and planning, ensuring system operability and maintainability, and evaluating and communicating operations and maintenance cost implications.

1.3 Cost Reductions and Containment

HART has implemented cost containment and cost reduction measures including exploring project delivery efficiencies by revising contract requirements and packaging strategies, brainstorming mitigations to known risks, implementing value-engineering principles to

reduce cost without compromising functional requirements, evaluating cost avoidance through an active lessons-learned program, evaluating soft costs (such as consultants), and proactively evaluating the costs and benefits of an interim opening. HART has also adopted recommendations from the recent APTA Peer Review and plans to hold a follow-on technical review by the end of 2017 focused on technical competency of its core group, interactions with utility companies, and contractual negotiations and administration.

HART and the Hawaiian Electric Company, Inc. (HECO) collaborated to address a significant cost risk associated with the guideway structure impinging on safety clearance areas for HECO's electric transmission and distribution lines. Although negotiations are still underway to fully manage this risk, HART and HECO identified alternative service maintenance vehicles to address the working clearance needed between HART's rail guideway and HECO utilities and associated steel and wooden poles. Additionally, HECO granted HART variances to their original clearance requirements in certain areas, allowing the Project to avoid costly overhead and underground utility relocations. The Airport Section Guideway and Station Group Contract (AGS) will use a combination of alternate service vehicles, increased Navy easements, and redesigned (re-framed) pole arms to avoid undergrounding the nine-pole 138 kilovolt (kV) system fronting Joint Base Pearl Harbor-Hickam. Addressing these issues thus far has resulted in Project savings of approximately $138 million in potential Project cost. The CCGS design team is reviewing plans with HECO to underground all of HECO's utility lines along Dillingham Boulevard. These efforts, along with the revised Risk Management and Project Controls structures and actions, are intended to contain cost and schedule growth associated with this specific risk.

1.4 Completion of the FFGA Scope

Using the project management techniques, risk analysis, cost containment, and project controls described in this Recovery Plan, HART has developed an updated Project Cost of $8.165 billion and an updated Revenue Service Date of December 2025. HART believes that this cost estimate and schedule are realistic and achievable. HART is committed to completing the original FFGA scope in accordance within this cost and schedule. HART acknowledges that the federal funding commitment for the Project is capped under the FFGA and that the additional funds needed to complete the FFGA scope must be provided from non-federal sources.

As described earlier, actions by the State Legislature and the Governor, and forthcoming local funding actions by the Honolulu City Council and the Mayor, have made the completion of the Project to Ala Moana Center—the original scope of the FFGA—achievable.

1.5 Conclusion

The Project is 38% complete, based on the weighted value of progress of the individual construction and design contracts. The Project is scheduled to open for passenger service on December 31, 2025, and has a current construction cost estimate total of $8.165 billion inclusive of contingency, excluding finance costs.

In addition to ongoing responsibilities and the actions stated in the Recovery Plan, HART's major upcoming milestones include procuring the CCGS Design-Build contract and HECO coordination. The CCGS Design-Build contract is the last major contract to be procured and the critical path for the overall Project. Utility relocation is a significant part of the CCGS Design-Build contract in Honolulu's urban core, and HART is proactively performing pre-construction Subsurface Utility Engineering and geotechnical work. These final contracts will benefit from lessons learned and value engineering (described in Section 4 of the Recovery Plan) as well as updates to Project Controls, particularly the robust MPIS and Risk Assessment.

This updated Recovery Plan lays out the local funding now available to meet the current cost estimate and complete the Project, not including financing costs. It also details a carefully developed and internally tested analysis of the Project's management capacity and capability, which has resulted in a management structure oriented toward swift implementation of project controls designed to manage identified risks.

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2 Project Background

2.1 Purpose of the Recovery Plan

The April 28, 2017, Recovery Plan submitted to the FTA included two options for completion of the Project. The inclusion of the second option, or Plan B, was due to the uncertainties regarding a dedicated source of funding at that time.

On Tuesday, September 5, 2017, the Governor of the State of Hawaii, David Y. Ige, signed into law Act 1, providing additional funding to the City and HART to complete a 20.1-mile and 21-station elevated rail transit system extending from East Kapolei in the west to the Ala Moana Center in the east.

This September 15, 2017, Recovery Plan, without the Plan B option, will demonstrate the following to the satisfaction of the FTA:

1. HART has the management and technical capacity and capability to successfully complete the full scope of work of the Project defined in the FFGA.
2. HART has developed a realistic and achievable updated Capital Cost Estimate for the completion of the Project.
3. HART has developed a realistic and logical updated Project Schedule that will assure the full Project can be opened to Revenue Service by the revised Revenue Service Date of December 2025.
4. The Grantee (City and County of Honolulu), working closely with HART, has identified dedicated sources of funding which will provide additional funding to make up the difference between the original FFGA Project Cost and the updated Capital Cost Estimate, through local financial resources that are stable, reliable, and committed to the Project.

This Recovery Plan sets forth documentation in support of each element outlined above and provides an updated report on the status of the current Project. Additionally, this Recovery Plan includes an updated Financial Plan based on the State Legislative and subsequent City actions that have been taken, as described in Section 6.2 below.

2.2 Project Description

The HRTP is a 20.1-mile-long fixed guideway rail system featuring 21 stations that extends from East Kapolei on the west side of the island of Oahu to Ala Moana Center on the east side via Honolulu International Airport. The alignment is elevated, except for a 0.6-mile at-grade portion at the Leeward Community College station. The system will be operated and maintained at the 43-acre Rail Operations Center (ROC, formerly known as the Maintenance and Storage Facility [MSF]) near Leeward Community College (LCC).

The system also features fully automated, driverless trains; a fare vending system; and passenger screen gates.

Figure 2-1 HRTP System Overview

2.3 Project History

The Project was preceded by decades of rail planning dating back to 1967, which has led to the current Locally Preferred Alternative (LPA) for the Honolulu High-Capacity Transit Corridor Project extending from East Kapolei to Ala Moana. Below is a chronology of key events in the Project's history:

- July 2005: The Hawaii State Legislature authorized—and in August 2005 the Honolulu City Council approved—a 0.5% GET surcharge to provide non-federal local funding for a new rail transit system.
- August 2005: The City Department of Transportation Services (DTS) initiated an Alternatives Analysis following the FTA Section 5309 New Starts Program (now known as the FTA Major Capital Investment Grant Program).

- January 2007: The City selected the LPA, steel-wheel on steel-rail, and began collecting the GET surcharge. The City then initiated work on the Project's Environmental Impact Statement (EIS) and preliminary engineering for the system.
- February 2007: The Honolulu City Council passed City Council Resolution 07-039 approving the selection of the Minimum Operating Segment (MOS) from East Kapolei to Ala Moana Center, via Salt Lake Boulevard. The MOS was subsequently amended to serve the Honolulu International Airport—deferring the Salt Lake portion of the alignment.
- November 2009: The City executed its first contract for the project, a Design-Build (DB) services contract with Kiewit Pacific Company for the West Oahu/Farrington Highway Guideway (WOFH).
- June 2010: The Final Environmental Impact Statement (FEIS) for the Project was approved by the FTA, with publication of the FEIS on June 25, 2010.
- November 2010: Oahu voters approved a City Charter Amendment establishing HART, to create a semi-autonomous public transit authority responsible for the planning, construction, operation, maintenance, and expansion of the City's fixed guideway mass transit system.
- January 2011: A Section 106 Programmatic Agreement was signed. FTA issued its environmental Record of Decision (ROD) for the Project on January 18, 2011, providing pre-award authority for utility relocation and acquisition of rail vehicles.
- February 2011: The HART Real Estate Acquisition Management Plan was approved, providing pre-award authority for Right-of-Way (ROW) acquisition.
- December 19, 2012: The City and the FTA signed an FFGA for a project consisting of 20.1 miles and 21 stations, a total estimated project cost of $5.12 billion with a committed federal share (subject to annual congressional appropriations) of $1.55 billion, and a full system revenue service date of January 31, 2020.
- January 2016: A five-year extension to the GET was adopted and was anticipated to yield $1.2 billion in additional local funds to the Project.
- June 2016: On June 6, 2016, the FTA directed HART to submit a Recovery Plan by August 7, 2016, which demonstrates that HART is working to contain costs and minimize delays in schedule impact. In July 2016, FTA extended the deadline to submit the Recovery Plan to December 31, 2016. Subsequently, FTA further extended the deadline for the submission of this Recovery Plan to April 30, 2017.
- August 24, 2017: HART cancelled the City Center Guideway and Stations Design-Build solicitation after analysis showed that cancellation would be in HART's best interest to do so. It has been over 2 years since the original CCGS Request for Proposals (RFP) was issued, and since then two of the three offerors have significant

changes to their Joint Ventures. Cancelling the solicitation would open the solicitation to other potential offerors to participate in the solicitation, which would enhance and encourage competition. HART also is of the opinion that changes contemplated to the RFP are so significant they necessitate a resolicitation. This particular delay and the continuation of the utilities relocation design documents enables HART to furnish to new solicitors signed and sealed drawings minimizing the associated risks assigned to this relocation work.

- September 5, 2017: The Hawaii State Legislature passed Senate Bill 4, 2017 Special Session (SB4), enacted into law by Governor Ige as Act 1, which extends the GET surcharge for three additional years, through December 31, 2030, and raises the Transient Accommodation Tax (TAT) from 9.25% to 10.25% for 13 years, until December 31, 2030. These measures will provide financial capacity needed to complete the project as planned in the FFGA.

2.4 Major Project Issues

The Project has been hampered by a number of events that were beyond the anticipation of the originating parties. These included issues related to the National Environmental Protection Act (NEPA) involving three federal cooperating agencies that arose very late in the EIS process as the Project was obtaining final signoffs from these agencies (which affected the alignment of the Project near the airport), historic preservation issues at the slated Pearl Harbor Station, and a Native Hawaiian Programmatic Agreement matter. Some early contracts also were awarded before final agreements had been reached with various third parties such as the University of Hawaii (UH) and its associated campuses, the State of Hawaii Department of Transportation (HDOT), HECO and other utilities, and other State and City agencies.

In awarding some early contracts, the Project did not sufficiently account for the necessary integration and interface activities between the major contractors or have a fully integrated Master Project Schedule. While some early contract awards were well-intended decisions designed to stimulate local construction jobs in the wake of the "Great Recession" of 2009 to 2011, when viewed in hindsight those decisions were mistakes on the part of HART that resulted in substantive cost and schedule impacts on the Project. Additionally, the single most costly impact to the Project, which was beyond the control of the Project sponsor as further described below, was the cessation of all construction activities for 13 months because of project litigation, which had a cascading effect on cost and schedule.

Below is a summary of key issues and their impacts to the Project:

- As a result of the NTP, AIS, and TCP delays, the Project incurred $172 million in delay costs on the two west-side guideway DB and the MSF DB contracts.
- The AIS delay was a 13-month delay that overlapped with the NTP delays on the west-side guideway and MSF DB packages.

- WOFH specifically incurred a total delay of 23.5 months and delay related costs in the amount to $107 million which includes construction escalation. (Note: This amount reflects only the WOFH, KHG, and MSF contract delay costs. It does not include associated costs [agency staff, rent, etc.] or legal costs that resulted from the delays.)

- In January 2011 a lawsuit was filed in state court that challenged the City's initiation of construction of the first section of the Project without completion of archaeological surveys and approval of the State Historic Preservation Division of all four project sections for the full 20.1 miles of the Project. The City's action was consistent with long-standing practice in the state for large construction projects, as well as being consistent with federal regulations.

- The initial ruling by the First Circuit Court of the State of Hawaii was in favor of the City and federal defendants, citing long standing construction practice in the state. The State's Intermediate Court of Appeals upheld the lower court's ruling on appeal. The case was then appealed to the Hawaii Supreme Court in 2012, which ruled in favor of the plaintiff by a vote of 9-0. This decision resulted in a cessation of all construction activities for nearly 13 months pending the completion of archaeological surveys for the entire project.

- A second lawsuit was initiated in Federal District Court in May 2011, by plaintiffs claiming that there had been inadequate consideration of alternatives in the EIS with regard to NPEA and cultural and historical sites. In November 2012, the court held that only three of the multiple claims by the plaintiffs required further analysis. However, the court also imposed an injunction on further work on the City Center segment of the Project and froze further acquisition of real property in downtown. The City initiated a Supplemental Environmental Impact Statement (SEIS) to address all three issues in December 2012, which was completed and released in June 2013. Upon review of the SEIS by the District Court, the court dismissed all of the claims of the plaintiffs.

- The plaintiffs then appealed the District Court decision to the Ninth Circuit Court of Appeals. In February 2014, the Ninth Circuit Court of Appeals upheld the lower court's decision, lifting the injunction and, with the prior resolution of the state court lawsuit, allowed the Project to resume construction.

- In March 2011, the City selected the contractor for the vehicle/core systems Design-Build-Operate-Maintain (DBOM) Contract, Ansaldo Honolulu Joint Venture (AHJV). Protests by the two unsuccessful contractors resulted in a nine-month delay in awarding the AHJV contract, which in turn resulted in a $8.7 million settlement of delay claims by AHJV. These costs have grown further as a result of yet additional collective project delays.

- As delays began to build as a result of these events, it became evident that the failure of the Project to sufficiently address the integration between the major contractors or have in place a fully integrated Master Project Schedule, as well as major assumptions for future contracts that would later prove to be incorrect, culminated in substantial negative consequences in the Project cost and schedule.

- To compound this problem, the Project experienced extraordinary increases in the cost of construction following these delays, as documented in the Ryder Levett Bucknall Comparative Cost Index of major United States cities from 2009 through 2016 (Appendix D). During the period of mid-2009 to 2011, when cost estimating for the FFGA was being completed, United States cities—including Honolulu—went through a relatively flat period of escalation in construction costs. Beginning in 2012, construction costs escalated significantly, with Honolulu's construction costs escalating to the highest construction costs among major cities in the United States, maintaining that position for four years through the fourth quarter of 2016.

- In March 2013, HECO stated that as a "rule of thumb" the minimum horizontal working clearances for their existing overhead lines were 50 feet for 138kV lines, 40 feet for 46kV lines, and 30 feet for 12kV lines. Based on recommendations from the Project's engineering and design consultants, action to address these specified clearances was deferred. This decision continues to have significant cost and schedule ramifications on the Project.

- In August 2014, the bids received for the construction of nine west-side rail stations exceeded budget estimates by more than 63%, or $100 million, signaling a major change in the construction market and resulting in the cancellation of the station solicitation.

- In the wake of the west-side rail station contract cancellation, a Project Risk Update presentation was made to the HART Board of Directors in November 2014, in which HART determined that the Project Cost would be $550 million to $700 million over the FFGA budget. Further, HART was faced with a persistent funding deficit stemming from overestimating the revenue yield from the GET surcharge and from a funding gap to replace $210 million in FTA Section 5307 funds (these funds were included in the FFGA Financial Plan, but then were required to be withdrawn from the Project's Financial Plan to assure those funds for use by TheBus), resulting in a total estimated budget gap of $910 million.

- In June 2015, the City and HART obtained approval of a five-year extension of the GET surcharge from the State Legislature. This five-year extension was anticipated to yield $1.2 billion in additional local funds to the Project, which increases the local/federal match ratio of the Project to a 75% local / 25% federal match. The Honolulu City Council adopted an ordinance to extend the GET surcharge for an additional five years to 2027 in January 2016.

- In January 2016, the City recommitted to the Project and announced its intention to seek an extension of the GET from the State Legislature and the City Council to cover the funding gap, consistent with the FFGA assurances imposed on the City in the event of a funding shortfall.
- In May 2016, HART received preliminary values for the Independent Cost Estimate (ICE) for the City Center Guideway and Stations DB package that indicated an estimated cost $719 million higher than anticipated. With the projected funding shortfall for the Project, the procurement of the City Center Guideway and Stations DB package was suspended, which shifted the entire schedule out to the end of 2024.
- In June 2016, the FTA directed HART to submit a Recovery Plan; in developing its Recovery Plan, and in particular in addressing overall project management and management capacity and capability issues, HART has identified and made a good faith effort to act on the lessons learned in the prior stages of Project development.

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3 Management Capacity and Capability

The purpose of this section is to describe HART's organizational structure, including key personnel, and to demonstrate its management and technical capabilities to successfully complete the Project within the proposed budget and schedule.

3.1 Overview

The HART Project Management Plan (PMP) describes the overall management approach for the HRTP and has been extensively updated since Revision 5. The sixth revision focuses on management of the project during construction and addresses comments and recommendations by the FTA's Project Management Oversight Contractor (PMOC) on project management and control procedures. HART will submit the PMP by November 2017.

3.2 Project Staffing and Personnel

Figure 3-1: Organizational Chart and Key Departmental Updates – Senior Management

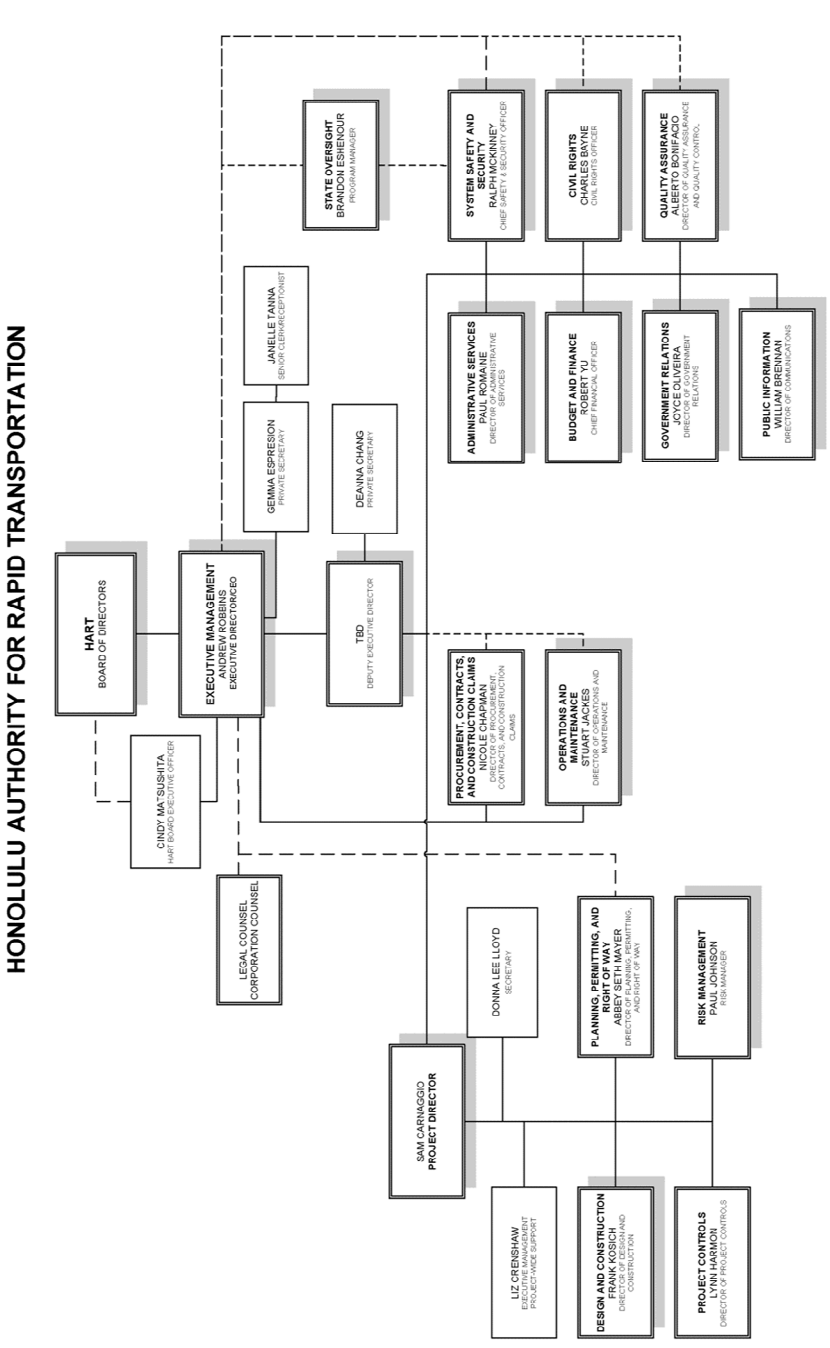


Figure 3-2: Organizational Chart and Key Departmental Updates – Design and Construction Division

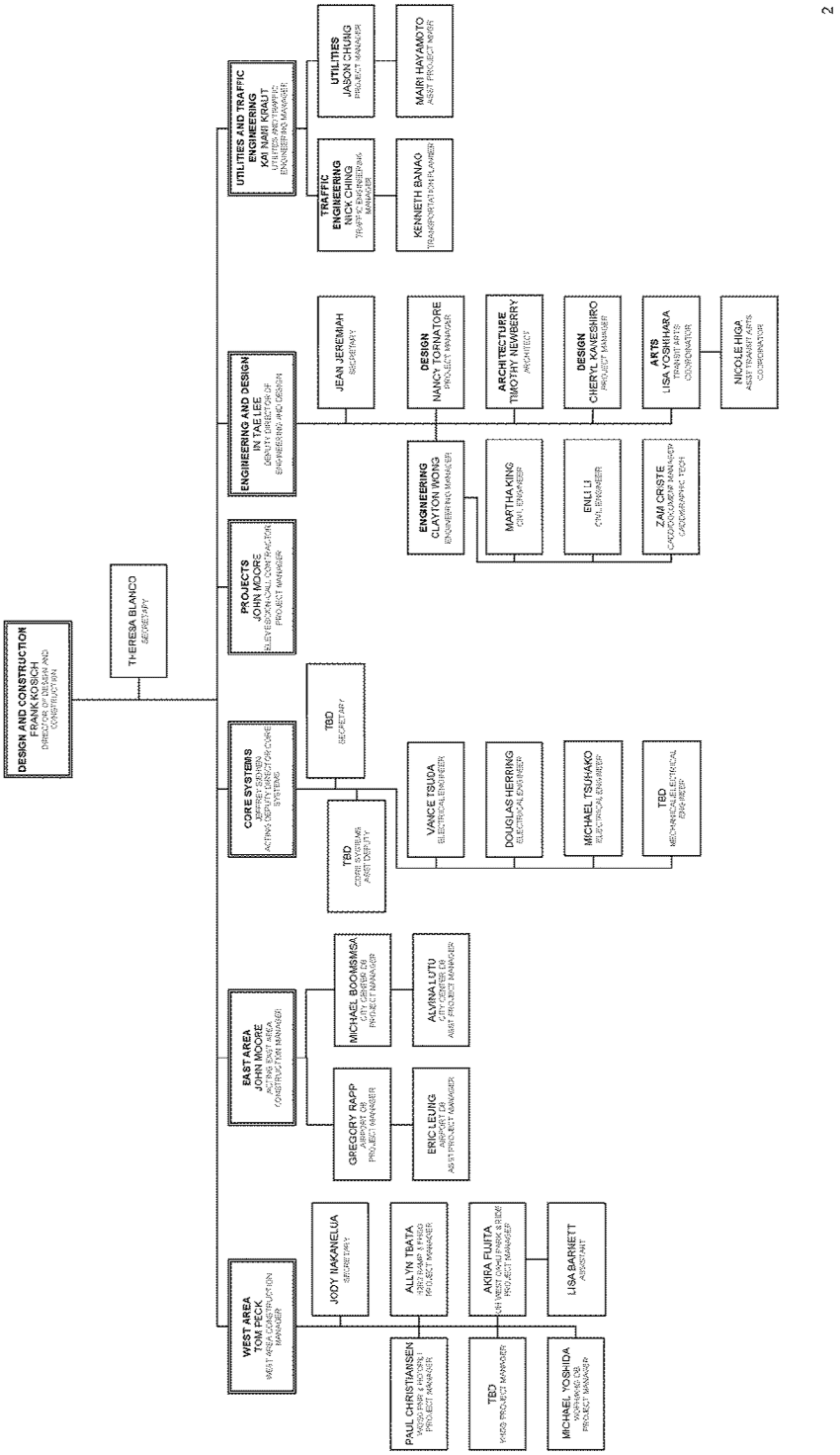
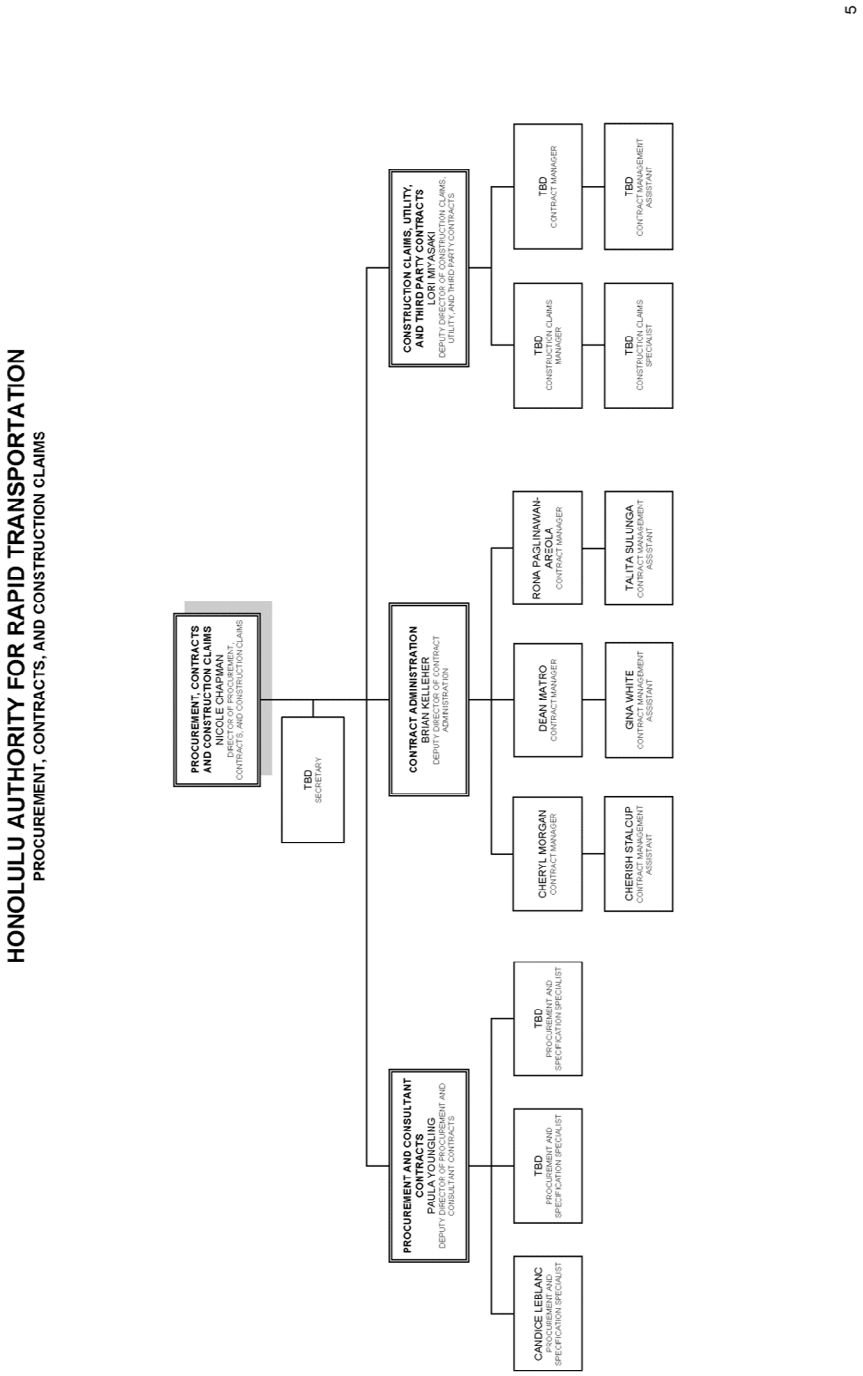


Figure 3-3: Organizational Chart and Key Departmental Updates – Procurement, Contracts, and Construction Claims Division



3.2.1 HART Board of Directors

HART is governed by a 10-member Board composed of the Director of the State Department of Transportation, the Director of the City Department of Transportation Services, and six volunteers from the community: three appointed by the Mayor, three by the City Council. The Director of the City Department of Planning and Permitting also serves as a non-voting member. The voting members appoint the tenth member to the Board.

The Board is the policy-making body of the authority and appoints and evaluates the HART Executive Director and CEO. The Board adopts HART's annual operating and capital budgets, adopts a six-year capital program, adopts rules and regulations, and carries out other duties as authorized by law. The Board's powers are primarily stated in the City Charter Section 17-104.

In November 2016, voters approved a Charter amendment clarifying the responsibility of the HART Board of Directors to establish policies and regulations regarding the development of the rail system, the internal management and organization of HART, and the allocation of decision-making authority between the Board and the agency's Executive Director and staff. To that end, the Board will be engaging in internal management policymaking regarding its approval of significant documents such as the Recovery Plan and will approve the same in the coming months. In addition, the Charter amendment additionally provides for the establishment of a rate commission and placed the operations and maintenance responsibilities for bus, paratransit, and rail with the DTS.

The current composition of the HART Board of Directors is particularly well-suited to address the current needs of the HRTP. Members contribute their substantial knowledge and experience in varied disciplines, including government, policy, construction management, financing, labor relations, law, public planning, and transportation. Board members provide a significant level of policy guidance and support in furtherance of the Project's goals; most recently, members have devoted a substantial amount of time in advancing GET extension legislation, the Recovery Plan for the FTA, and the hiring of the Interim Executive Director and CEO, as well as the search for and appointment of the permanent Executive Director and CEO.

3.2.2 Executive Director and CEO Search

The Board of Directors, with the assistance of executive search firm Karras Consulting, identified Andrew S. Robbins, P.E., as HART's new permanent Executive Director and CEO. Mr. Robbins, who has extensive experience in project management and engineering, systems engineering, construction and installation, operations and maintenance, business development, as well as substantial firsthand knowledge of driverless transit systems, took the helm at HART on September 5, 2017. Interim Executive Director and CEO Krishniah N. Murthy is working collaboratively with Mr. Robbins to ensure a smooth transition. See Appendix E for Mr. Robbins' curriculum vitae.

3.2.3 Qualifications of Key Personnel

HART understands the critical nature of consistency as it relates to project management and the success of the Project. This understanding has led HART to establish the following core group of individuals who have extensive transit and construction experience and the values required to successfully complete a project of this magnitude:

- **Andrew Robbins, Executive Director and CEO:** Mr. Robbins is a licensed professional engineer in the U.S. with a career spanning more than 37 years. Mr. Robbins has been involved in numerous transit systems located domestically and internationally, at airports and within urban areas, having worked as a Field Engineer, Project Engineer, Project Manager and Business Development Executive. Mr. Robbins has a specialty in driverless transit systems with hands-on experience in project management, project engineering, systems engineering, construction and installation, operations & maintenance and business development. Mr. Robbins has most recently led efforts in project development, bidding and contract negotiations for many transit projects in the United States including in Denver, Las Vegas, San Francisco, and Los Angeles.

- **Krishniah Murthy, Interim Executive Director and CEO:** Mr. Murthy has over 45 years of professional experience in rail transit programs. In his last assignment before his retirement, Mr. Murthy was the Executive Director of Transit Project Delivery for the Los Angeles County Metropolitan Transportation Authority (MTA) from 2007 to 2014. At the end of his tenure, the program had approximately $9 billion of projects in various stages from concept to construction. Prior to his MTA engagement, Mr. Murthy had 35 years of transit project design and construction experience working on various U.S. and international projects including Atlanta, Dallas-Fort Worth, Phoenix, San Diego, Los Angeles, New Delhi, and London.

- **C. S. Carnaggio, Project Director:** Mr. Carnaggio has 35 years of experience in design and construction in the transportation industry, with the last 18 years of his career being exclusively in transit. He brings a unique combination of experience at both federal and regional transit agencies, having served for four years at FTA as the Director of Engineering and 14 years delivering capital projects for regional transit agencies such as WMATA and MTA in Baltimore. Having delivered major projects very similar to the HRTP, Mr. Carnaggio's leadership experience and transit knowledge provides HART with the assurance that sound delivery decisions are made.

- **Robert Yu, Chief Financial Officer:** Mr. Yu has over 25 years of experience in the public transportation industry. Prior to joining HART in March 2017, he served as Senior Vice President and Deputy General Manager for Oahu Transit Services, Inc. (OTS), the operator and manager of Honolulu's bus and handi-van system, from 2009 to 2017 and Vice President of Finance and Administration from 1992 to 2009. Before his career in public transportation, Mr. Yu held various financial and audit

positions at Chevron USA and Grant Thornton CPAs in San Francisco and Hawaiian Electric Industries in Honolulu. He is a Certified Public Accountant.

- **Frank Kosich, Director of Engineering and Construction:** Mr. Kosich has over 37 years of project and program management experience and has managed major projects in the United States and abroad both in the private sector and as a Commander and District Engineer with the U.S. Army Corps of Engineers. His most recent assignment, prior to joining to the HART project, was with Metropolitan Transit Authority Capital Construction, as Senior Resident Engineer for the Second Avenue Subway Core Systems contract in New York City. His oversight and relevant experience matches well with the current ongoing design and construction.

- **Nicole Chapman, Director of Procurement, Contracts, and Construction Claims:** Ms. Chapman has been with HART for four years and has over 20 years' experience in procurement and contracts, including serving as procurement and contracts legal counsel for the City and County of Honolulu and the City and County of San Francisco. Prior to working in the government sector, she worked for a defense litigation law firm and served as in-house counsel in the Bay Area and Hong Kong. Ms. Chapman's local knowledge relating to construction contract procurement and interpretation of agreement language adds to HART's ability to manage contracts.

- **Lynn Harmon, Director of Project Controls:** Ms. Harmon has over 25 years of industry experience working for some of the largest public sector clients as well as Blue Chip private sector companies. She has experience in providing cost engineering, estimating, scheduling, change management, risk management, progress reporting, and contracts administration throughout the life-cycle of both traditional and complex Design-Build projects. Ms. Harmon's varied experience includes transit projects across the Middle East and Los Angeles Metro Heavy Rail Subway Systems, Light Rail Systems, and Metrolink Commuter Rail System. She is currently a Treasurer on the Women in Transportation Hawaii Chapter.

- **Abbey Seth Mayer, Director of Planning, Permitting, and Right of Way:** Mr. Mayer has approximately 15 years of experience leading planning organizations in the state of Hawai'i, including serving as the State Planning Director from 2008 to 2011. For the last 6 years, he served as the president and founder of Mayer & Associates Consulting, Inc., a Honolulu-based consulting firm participating in a wide variety of projects, including private developments, government planning initiatives, government-financed affordable housing developments, and large-scale alternative energy projects. Mr. Mayer's local knowledge and expertise concerning the programmatic requirements has earned the confidence of FTA and PMOC.

- **Stuart Jackes, Director of Operations and Maintenance:** Mr. Jackes brings 37 years of experience in automated rail transit operations and maintenance, policy, planning, regulation, economics and logistics, much of it with SkyTrain in British Columbia. He has been involved with a number of system expansion projects and

was the Project Operations Manager on the TransLink Evergreen Line Rapid Transit Project and brings a career of extensive knowledge of automated rail transit to the HART project. Mr. Jackes' hands-on experience in fully automated transit operations well serves the need for details critical to the operation and safety of the HRTP.

- **Ralph McKinney, Chief Safety and Security Officer:** Mr. McKinney has 19 years of experience in safety certification in the transit industry. He is a technical expert on programs, regulation, and compliance with FTA, FRA, TSA, USDOT SSO, and APTA policies and standards. Mr. McKinney's experience also includes acting as a liaison with State and Federal agencies regarding safety and security certification at the Chicago Transit Authority and the Utah Transit Authority.

- **Jeff Siehien, Acting Deputy Director Core Systems:** Jeff has 25 years of experience in engineering and program development for major transit systems. His expertise is in developing new technology systems and upgrading existing systems. Additionally, Jeff' brings a full understanding of design impacts on ridership, operations and maintenance. His previous experience working for NYC Transit included training and mentoring engineers in operations and maintenance throughout the design, construction, and testing lifecycle of the system. Jeff also developing training protocols as part of his responsibilities to make sure personnel was qualified to operate and maintain the system.

- **Kai Nani Kraut, Stakeholder Engagement Manager:** Ms. Kraut is a licensed engineer and a certified construction manager who brings relevant knowledge and experience from working directly for the City and County of Honolulu as the former Deputy Director of Transportation Services and previously for FHWA Hawai'i Division as the Utility Liaison and Transportation Engineer for Oahu, Maui, and American Samoa. In her over 23 years of experience, Ms. Kraut has represented the federal, state, and city governments and understands the requirements of federally funded construction projects. Within the last 15 years in Hawaii, she has participated in some of the largest transportation projects in the state and several ARRA transit projects with the City. She understands the stakeholders' needs and policies and is able to navigate them to aid a project's success.

- **Thomas Peck, West Area Construction Manager:** Mr. Peck is a licensed engineer with over 35 years of successful leadership in a broad range of multi-level management positions including international experience in engineering, contracting, construction, and program/project management. His experience includes the $4.2 billion Second Ave Subway project in New York City and the $35 billion Roads and Drainage Program in Qatar. He held multiple positions in the US Army Corps of Engineers including holding a Federal contracting warrant.

- **John Moore, Acting East Area Construction Manager:** Mr. Moore has over 46 years of experience in management, design, and construction of major public and private works projects, including transit. As a licensed contractor in Florida, he was the

qualifier for Stone and Webster and later for URS. Mr. Moore was also recognized by the courts in Dade County Florida as an expert witness in Construction. For the past six years with HART, he has had various responsibilities, including being the Deputy Resident Engineer for the KHG contract; leading the completion of the AIS trenching; being the lead in resolving the delay and escalation claims received from Kiewit for the MSF, WOFH, and KHG contracts; being the Project Manager for the On-Call Contractor and the Elevator and Escalator contracts; and is currently the Interim Construction Manager for the Airport and City Center portions of the system, including the remaining twelve stations.

- **Paul Johnson, Director of Risk Management:** Mr. Johnson has 37 years of experience in facilities project management and construction, including leading cost containment/cost reduction sessions on many projects and programs including rail transit, highways, and water systems. He is a Certified Value Specialist (CVS) through SAVE International, and as an experienced facilitator is working with HART teams on risk identification and mitigation such as utility interface. Mr. Johnson recently completed a 2-year assignment as Director of Logistics on the World Cup Programme in Qatar. The assignment involved close coordination with Qatar Rail for development of the country's rail transit stations and the tunneled guideway. Mr. Johnson's experience as an owner's representative and construction manager includes numerous forms of project delivery such as Design-Build, Design-Bid-Build, and Prime Contracting, all of which have applications on the remaining contracts in the HART project.

3.2.4 Staffing Strategy and Approach

HART continues to actively recruit through its website, industry periodicals at the national level, and local media, as well as outreach to local agencies and engineering firms. HART has successfully recruited highly qualified individuals to fill the Chief Financial Officer, Deputy Director of Procurement, Director of Design and Construction, Safety Certification Manager, and Risk Manager positions, with the full support of the Office of the Mayor. HART is currently interviewing candidates to fill the recently vacated East Area Construction Manager and Deputy Executive Director positions. HART anticipates filling these key positions within the next several months. Recent meetings with the Office of the Mayor and the City's Department of Human Resources to establish a plan that provides stability for essential Project personnel have been encouraging. The passage of SB4 and Act 1 has provided HART an opportunity to look at the Project delivery as a whole, including revenue operations. This opportunity will be wed to an evaluation of the organization structure as a whole, including evaluation of needed core competencies. Staffing levels and management competencies required for cost-effective delivery of the Project will be the guiding factor.

HART's hiring and retention issues are not specific to rail construction personnel but have occurred at all levels of staffing and in all division of HART, including the administrative offices which do not require any form of rail or even construction experience. HART is also

committed to employee retention by developing a succession plan focused on career progression, preparation for leadership roles, retaining institutional knowledge, and fair compensation for local staff. In addition, HART has taken the first steps to create an employee-friendly working environment with minimal stress and a corporate policy of positive communication and staff support.

3.3 HART Process and Procedure Changes

The following section describes changes to HART's processes and procedures which have been implemented to control costs, maintain schedule, and provide credibility in reporting moving forward.

3.3.1 Management of Current Contracts

3.3.1.1 History of HART Change Procedure

HART's Change Management program attempts to minimize the financial impact of Contract Change Orders to the Project. While Change Orders are not completely avoidable, proper policies and procedures can minimize their number and severity. HART has engaged the services of Mr. Henry Fuks, who was a Los Angeles County MTA construction manager for over 2 decades and has vast experience in managing large-scale projects with similar challenges. In April 2015, HART established a Contract Administration Division in an effort to streamline and bring uniformity to the contract change process. Additionally, HART recognized challenges that had not been addressed by the initial Contract Change Procedure (5-CA-11) and revised it accordingly. The following key areas were addressed:

- Revision 1 (August 2015):
  - The role of Contract Managers, who would review merit determination and negotiation strategy memos, was established.
  - Contract Managers were given the responsibility to prepare the Change Order documents to streamline and bring uniformity to the process.
  - Contract Administration implemented a "single Change Order file" process, which included checklists of all required documents.
  - A Time Impact Analysis (TIA) narrative was required as part of the supporting documentation for a Change Order.
  - The Project Manager was required to obtain funding and funding availability in advance of proceeding with a change, rather than at the end of the process, when presenting the change for approval.

- Revision 2 (September 2016):
  - Language was added to expressly state that HART does not allow "parceling" or piecemealing changes to avoid Board approval. (Note: This language was included in an abundance of caution and to demonstrate that HART was not in the business of implementing changes in this manner.)

3.3.1.2 Implementation of Further Improvements

In January 2017, the Interim Executive Director and CEO rolled out a change to the HART organizational chart, whereby Procurement, Contract Administration, and Construction Claims were gathered under one division and the Director of Procurement, Contracts, and Construction Claims would report directly to the Executive Director and CEO. This change was made to institutionalize checks and balances for change orders by having reviews conducted by an entity independent from the Project Management team.

In June 2017, HART rolled out Revision 3.0 of Procedure 5-CA-11, "Contract Change Procedure," in which revisions were incorporated to institute more checks and balance to the change procedure. Revisions include:

- Implementing a Change Control Committee for all contract changes over $500,000. This will provide management an opportunity to review the change from a programmatic perspective for changes greater than $500,000 or where a change is discretionary. (All changes greater than $1,000,000 will continue to be subject to HART Board approval, as a continued check and balance.)
- Delegating authority to the three Deputy Directors of Procurement, Contracts, and Constructions Claims Division on the finding of merit of non-discretionary change requests with estimated value equal to or less than $500,000 to streamline the change process and minimize delays.
- Establishing time procedures with timelines for resolution at each phase of the process. The timeline enforcement dictates speedier resolution of issues, and the issuance of Change Orders, where needed, will be timely.
- Providing clearer direction to the field team on the use of unilateral change orders.
- Requiring a schedule network, in addition to the TIA narrative. The network is defined as the sequence of new activities that are proposed to be added to the existing schedule, which identifies the predecessors to the new activities and demonstrates the impacts to successor activities. This will allow for a more effective evaluation of the impact to the baseline activity.

With these revisions, the HART Procurement, Contracts, and Construction Claims Division will be able to provide stronger leadership in the change management process and work closely and rigorously with the field team on the terms, conditions, and specifications of the contract and proper and sufficient documentation.

3.3.1.3 Improvements to Contractor Interface

Coordination between Contractors to ensure the plans and specifications and work in place of one coincide with the work of another (either follow-on or concurrent work). Below are some issues that took considerable time and effort to coordinate and resolve through our interface processes:

- Peripheral Device locations (PA speakers, CCTV, fire alarms, etc.)
- Number, sizes and types of conduit (including cable segregation requirements)
- SCADA cabling and coordination requirements
- Conduit configurations in canopy supports
- Location and configuration of CIC Cabinets and associated conduit
- Access control for door entry (card readers; electric locks, strikes and hinges)
- Coordination of base plates installation with Passenger Screen Gates
- Fare Gates locations and configuration
- Provisions in station layout and infrastructure for future elevators
- Coordination and interface with third parties to discern requirements, procedures, and resolve issues associated with the delivery. Key partners include but are not limited to:
  - Hawaiian Electric Company
  - HDOT
  - City of Honolulu DPP
  - US Navy
  - Aloha Stadium Authority
  - DTS

Additionally, HART recently established a Strategic Stakeholder Engagement Group to lead engagement and resolution activities with strategic partners in a forward-looking, proactive manner. This group will develop and implement stakeholder engagement strategies including informing, consulting, and involving stakeholders where relevant and evaluating the effectiveness of those strategies. It is important to ensure senior management is apprised of issues and risks to stakeholder relationships as they arise so that risks may be managed effectively.

3.3.2 Project Controls

3.3.2.1 Project Controls Overview

Project Controls includes the data gathering and analytical processes used to predict, understand, and manage the cost and schedule outcomes of a project. For any major transit project, effective Project Controls are a critical element of successful project cost and schedule management.

In 2013 the Project's General Engineering Contractor, who provided significant schedule and cost estimating support for HART, was replaced which created a vacuum in knowledge that has taken time to fill. To address these issues, and to provide more robust and effective project controls system, HART has obtained the services of a specialty firm to evaluate the HART Project Controls processes and provide a system assessment to explore what is currently in use and to assist in the implementation of any changes that are deemed appropriate to enhance effectiveness and efficiency, to provide a more robust system solution to manage the project.

HART primarily relies on Oracle's Contract Management System (CMS) to manage the project. CMS is the Project's central data repository and reporting system to manage the flow of project documents and control project cost. The Condition Assessment Report identified key system and process improvements, as discussed below:

- CMS and the City's accounting system are not connected, and staff members manually enter financial information into both systems. Manually entered data is prone to error and takes longer to process because of duplication of effort in entering the same information into multiple databases.
- Bottlenecks exist in document processing because of limitations in the electronic sequential review process. Duplication of effort occurs as project staff are required to enter review comments manually on hardcopies and simultaneously electronically in the system.
- Using multiple databases requires manual reconciliation to detect manual data entry errors, variances, and other inconsistencies between various systems.
- Drafting monthly reports requires the HART Project Controls Division (Project Controls) to rely on different reports from various systems and manual input from other divisions every month. HART currently has no single complete repository of project data for report generation.
- The current interface could be more user-friendly, intuitive, and simpler to use.

In response to the issues highlighted above, Project Controls presented recommendations to executive management in August 2017 and is awaiting management decision to proceed with system upgrade. Meanwhile, Project Controls is committed to simplifying and

implementing business processes more efficiently, centralizing the focus of information on analysis, reporting, and communication.

3.3.2.2 Trends

The Project has undergone major scope revisions and approved changes yielding significant cost and schedule impacts. In dealing with this and potential cost escalations, Project Controls performs rigorous and continuous predictive analysis in key areas of where costs can be reduced or schedule delays can be mitigated. The August 24, 2017, cancellation of the CCGS procurement has given HART the opportunity to explore options to optimize cost and schedule. Project Controls is in the process of thoroughly analyzing the potential of these opportunities. As this analysis is still in process, the current Basis of Estimate and Basis of Schedule assume no change since the previous Recovery Plan submission.

The current budget and schedule will undergo a re-baseline once this Recovery Plan is adopted. Once established, forecasting cost and schedule variances to the re-baseline will be documented through a new trend report process. The trend analysis will allow for and document early detection of potential cost overruns, schedule slippages, and project risks associated with individual contracts or interface elements of the Project. Project Controls monitors the approved project budget and documents potential variances throughout the life of the Project. Project Controls is also tracking any changes to the original project scope of work which result in an increase to the Project's approved budget, as they can only be submitted for approval by the Board after a committed funding source has been established.

3.3.2.3 Cost Contingency

The cost contingency will be managed as a reserve fund by HART management. Contingency is allocated at the Contract Packaging Plan (CPP) level to address any unforeseen costs or risks related to design development, construction, and other Project conditions. Contingency is allocated based on inputs from HART's Risk Manager, and reduced or accounted for, as design, construction, and procurement progress, uncertainty and the potential for risk events are quantified in the Risk Model. A contingency drawdown curve will be established and managed via the Trend Process to ensure appropriate levels of contingency are managed and reported.

3.3.2.4 Master Project Integrated Schedule (MPIS)

The Project Master Integrated Schedule is the chief program management tool that ties information for all elements of the Project together and provides the necessary assistance in the planning and management of a complex execution plan for the Project. It is developed with a supporting basis and assumption report and is comprised of a hierarchy of program tasks and benchmark interim milestones, through both an Interim and System-wide Revenue Services Date (RSD).

Over the past several months, Project Controls has undertaken a new course in enhancing the MPIS by shifting the focus back to using the schedule as the central point of

communication in analyzing progress and reporting metrics to both a field level and executive management level. In its reviews of the present state of the MPIS, Project Controls identified critical areas of deficiency that were preventing the MPIS from being able to be used as a tool to meet this focus:

- There was a lack of consistency in the use of activity coding, calendars, and Work Breakdown Structure (WBS) coding.
- The schedule updating procedures needed to be revised.
- There was a lack of owner-specific and third-party interface information in the MPIS (such as inclusion of Regulatory Agency approvals, inspections, certifications, and other utility activities—such as utility relocation and HECO power and activation activities).
- There was a disconnect of inter-project logic ties of Major Milestones and Critical Access Milestones (CAMs) to schedule activities.
- There was an unclear Critical Path at a Program Level.
- Total Float values were inconsistent and excessive, requiring a review of logic ties (as they may be missing successor tie[s]).
- Constraints, specifically hard constraints, were being used throughout the MPIS to hold a date in the system. This presented an issue, in that it would override the sequencing logic used for forecasting and accurate reporting of any potential forecasted delays.
- Integration of testing activities from the feeder schedule was missing in MPIS.
- Safety and Security activities are not updated or accurate in the MPIS.
- There was a lack of detail for upcoming planned work (information for the east-side segment shown at a planning level).
- There was a lack of standardized schedule reports and look-aheads of the MPIS information.

In the past, the construction portion of the MPIS schedule was updated by uploading the received contractor progressed schedule directly into the MPIS. This was recognized as a concern that was quickly rectified. Presently, monthly updates are validated through the Resident Engineer, Inspector, and Project Manager.

Project Controls has prioritized its effort on performing the following initial Quality Control checks and validations:

- Total float values
- Use of constraints
- Activity coding and WBS coding

Project Controls is presently revising affected activities to correct or eliminate them as appropriate. Many of the adjustments incorporated into the MPIS over the past several months are the biggest contributing factors to establishing an integrated schedule. It is important to note that additional work is necessary with respect to the WBS coding effort and continued detailing of the east-side segment of work, which is expected to be an ongoing work in progress.

In addition, Project Controls recognized a general deficiency in how it was interacting with the Project's internal groups. Project Controls has initiated a stronger communication and coordination effort with the HART Division Directors that has resulted in an enhancement of the detail and integrity of the schedule information, specifically for interface, turnover of activities and milestones, levels of detail information within the schedule, and accurate logic ties. A majority of logic detail has been incorporated in the MPIS leading up to the Interim RSD, but it is expected to be further defined for the complete system-wide RSD especially for the Eastside segments, as detailed information from Testing, Safety and Security, and other portions of work is incorporated. Information is presently at a summary level in these areas, but additional details from these sections are anticipated to be completed by end of 2017.

In parallel to this work effort, Project Controls is reviewing and realigning its scheduling procedures and methods; Time Impact Analysis objectives and recommended methods; and standardized report formats and layouts that include an analysis section for the schedule information for visibility and consistency. Project Control's objectives continue to be re-aligned to implement industry standards, specifically in schedule-level reporting presentations that will be aimed at the project, senior, and executive management levels for their respective review and oversight.

This realignment in Project Controls' processes is has led into the development of a new internal Monthly Schedule Report, with sections feeding into the published Monthly Project Status Report, as appropriate. The internal report shows more detailed layout options; a Critical Path and Analysis section; a Look-ahead Schedule; a Major Milestone and Critical Access Milestone Schedule and Analysis section; Third-Party Turnover and Interfaces section; a ROW section; a Core Systems, Testing, and Analysis section; and an Area of Concern section—to identify present and potential issues.

Project Controls' goal is to enforce the MPIS and make system reports available as a centralized tool for communication and presentation of current Project status and critical

activities; analysis of any variances; identification of issues or concerns, mitigations, or recommendations; and workaround plans.

3.3.2.5 Schedule Contingency

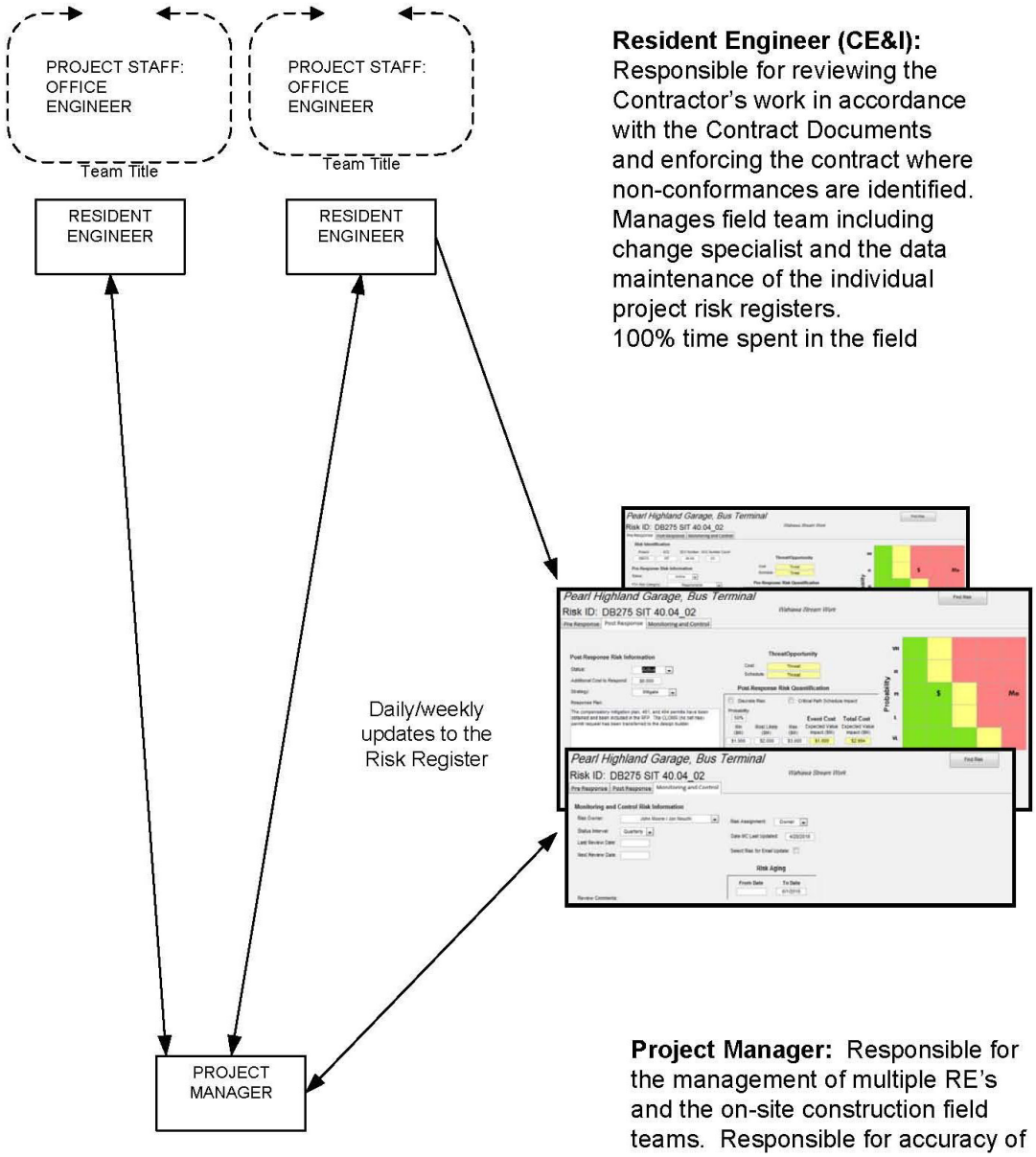
Schedule contingency is carried as an activity in the MPIS for Interim Opening and Full Revenue Opening. The amount of contingency for Full Revenue Opening is currently the difference between an earlier, best-case opening date and December 2025. HART's Risk Model quantifies the required contingency to cover total impact to the Critical Path for each item of risk based on input from the Risk Manager. HART will manage and update all risks that may affect completion of the Project within the approved schedule on a monthly basis and re-run the network model on a quarterly basis.

3.3.3 Risk Management Program

The HART Risk Management Program helps to establish confidence in the HRTP cost and schedule projections. The Risk Program includes the identification, categorization, and assessment of risks and opportunities (R&O) related to each individual contract. A network risk model uses a bottom-up risk assessment to define cost and schedule R&O impacts for each contract to other contracts, and to the Project as a whole. In 2016 HART increased its focus on risk with the implementation of formal risk modeling efforts that include rigorous analyses and cross-departmental meetings to determine mitigation strategies. Quantifying the cost and schedule R&O impacts will assist the Project team in decision-making and risk management. HART has also developed a monitor and control process that generates reports to assist the Risk Manager and Project Managers in tracking contingency funds.

The weaknesses in the west-side DB contracts, including contract language and requirements as described below, are identified as risks for AGS and CCGS and are top mitigation priorities. The Risk Management Program process flowchart is depicted in the following figures:

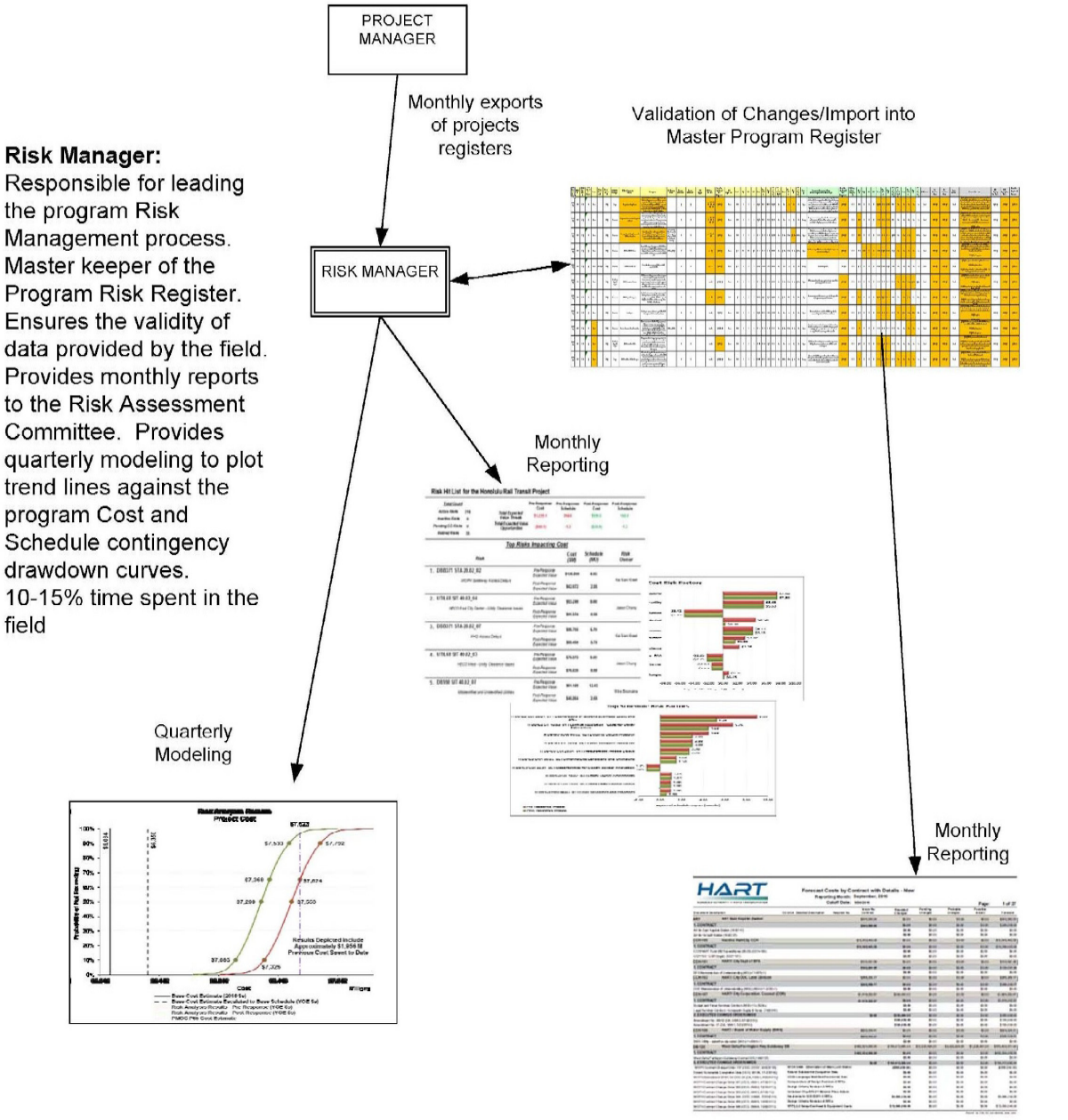
Figure 3-4: Field Office Risk Management Flowchart



Resident Engineer (CE&I): Responsible for reviewing the Contractor's work in accordance with the Contract Documents and enforcing the contract where non-conformances are identified. Manages field team including change specialist and the data maintenance of the individual project risk registers.
100% time spent in the field

Project Manager: Responsible for the management of multiple RE's and the on-site construction field teams. Responsible for accuracy of the information entered in the risk register including identifying new risks.

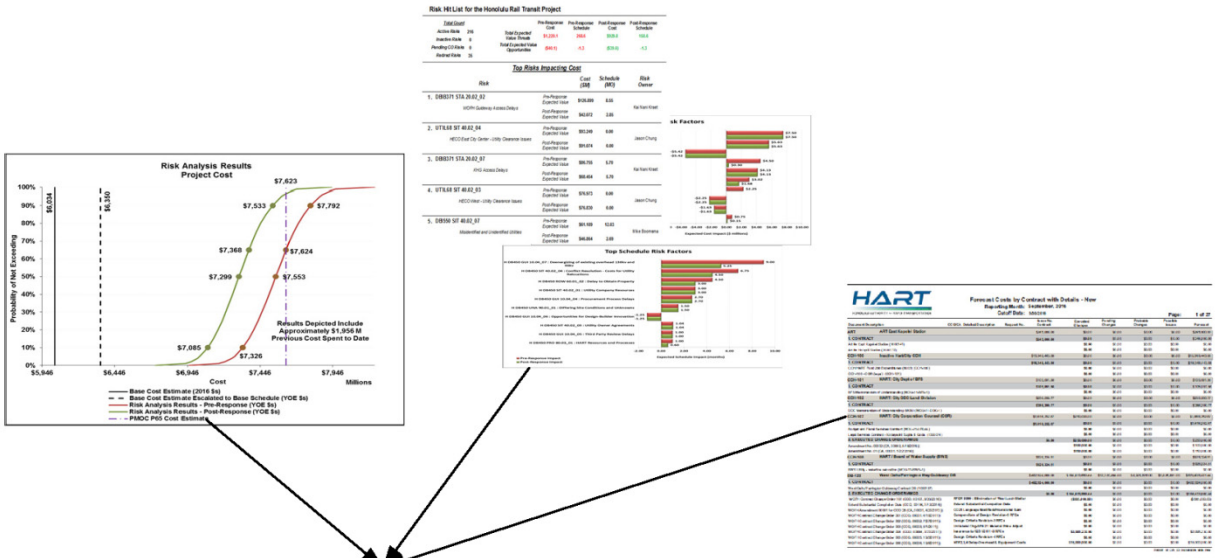
Figure 3-5: Risk Manager and Project Controls Flowchart

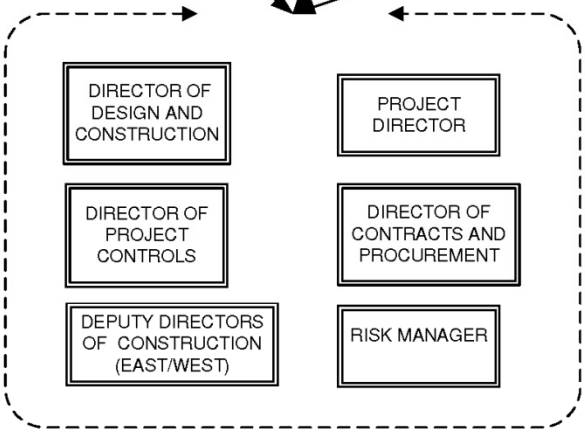


Risk Manager: Responsible for leading the program Risk Management process. Master keeper of the Program Risk Register. Ensures the validity of data provided by the field. Provides monthly reports to the Risk Assessment Committee. Provides quarterly modeling to plot trend lines against the program Cost and Schedule contingency drawdown curves. 10-15% time spent in the field

RMS/Project Controls: Will receive a monthly export from the RMS system during the 2nd week of every month. This export will be imported into CMS to track and run forecast reports (shown below) to be provided to executive management and the PMOC.

Figure 3-6: Risk Management Reports and Committee Flowchart





RISK MANAGEMENTMENT COMMITTEE

Modeling and Reporting: Modeling will occur on a quarterly basis resulting in updated cost curves, cost and schedule contingency drawdown curves, and extended overhead delay costs.
On a monthly basis, a summary of top risk by project and program will be produced along with cost and schedule tornados. This report along with the monthly forecast will inform management on the health of each project and the program as it relates to cost and schedule.

Risk Management Committee: Consisting of the positions shown above. This committee will meet monthly to review the health of the program as it relates to the RCMP planned contingency drawdown curves as well as the near-term and long-term risk exposures. The reports will be provided by the risk manager and meetings will be chaired by the Project Director. Purpose of the meeting will be to give the executive managers insight from the field of what challenges the teams are facing and what mitigation strategies are being employed in the field. Pending change orders as well as future change orders would be discussed within this group as well.

The Project is currently monitoring 215 active risks and has closed or retired 132 risks since June 2016. The following is a list of the top three known cost risks, which account for $384 million, or 47% of the total risk profile:

- Re-baselining the Core Systems Schedule to meet a Final Overall Baseline Schedule, extending the RSD from January 2022 to December 2025
- Working with HECO to relocate the overhead utilities on the west side to underground locations
- Conflict resolution pertaining to costs for relocations of unknown utilities in the City Center segment

The top schedule risk is the delay of the Core Systems schedule by 77 months (from mid-2019 to completion of CCGS in 2025). Core Systems is delayed as a result of delayed completion of the east-side projects.

Further schedule risks are less significant and are concurrent with (not additive to) the Core Systems schedule delay, such as:

- Misidentified or unidentified utilities which might occur in remaining west-side efforts or east-side contracts (a delay of 2 months)
- HDOT or DTS requirements for conformance with their standards (a delay of 6 months).

A more comprehensive listing of the cost and schedule risk factors is included in Appendix C. This excerpt from the Risk Tractability Log shows how each risk factor includes a detailed description, a pre-response estimate, a post-response estimate, and the individual risk owners. It also shows the overall risk and potential recommended mitigation for the program.

HART has developed a risk management plan and is committed to enacting cost containment and value engineering measures as a primary tool to maintain the Project's capital cost within the established budget.

If needed, HART also has a number of strategies to mitigate these downside risks, including:

- Additional debt capacity available to the City through the issuance of GO debt.
- Utilizing its existing TECP program for short-term financing needs.
- Extending local revenue sources, in the following order of priority, such as:
  - City subsidies, which requires City Council approval.
  - GET surcharge and TAT revenues, which requires legislative amendment.

In the process of preparing this Recovery Plan, HART determined that certain legal risks regarding ROW acquisitions and relocations had never been fully captured in extant risk

assessment models. Many of these risks relate to the wide range of possible jury verdicts with regard to property valuations in eminent domain trials. However, given the sometimes unpredictable and uncontrollable results of jury verdicts in eminent domain trials, HART believes it most prudent to disclose the potential for risk in excess of budgeted amounts in the updated financial plan. HART has determined that a full re-assessment of its total allocated and unallocated risks for the entire project, inclusive of ROW risks, needs to be performed at this time and has kicked off a series of workshops to this end. By fully assessing both risks and opportunities, by and recognizing that a substantial portion of the work has already been completed, HART is confident that its current contingency budget will be adequate to cover remaining risks on the Project.

3.3.4 Operations and Maintenance Roadmap

The HART O&M Developmental Division (HART O&M) is dedicated to containing costs and maintaining scheduled openings by ensuring a seamless transition from capital construction and commissioning to operation and maintenance of the system. The approval of the 2016 Charter Amendment 4 to the Revised Charter of the City and County of Honolulu 1973 (2000 edition), as amended, places operations and maintenance responsibilities for rail with DTS. HART O&M meets regularly with DTS leadership to actively work on a roadmap to revenue service. HART and DTS also discuss DTS's branding initiatives for the rail system and fare system card. In addition, leadership of HART, DTS, and OTS meet on a monthly basis to develop planning for intermodal (bus-rail) service integration and Transit-Oriented Development (TOD) to improve system connectivity needs in relation to current design and construction.

HART O&M is also working toward a seamless transition to DTS by leading the O&M organizational and procedural development, including its continued commitment to hiring and training local staff and fostering its ongoing relationship with the Leeward Community College Workforce Development program. A proactive approach to O&M staffing will allow HART O&M to build institutional knowledge and dedicate adequate resources to develop the policies, procedures, and programs (such as the Transit Asset Management Program) needed to ensure HART's success during the transition to and start of system operation.

HART O&M will also continue to assist with ensuring operational readiness and cost containment by evaluating and communicating operations and maintenance implications to Project decision-makers and stakeholders and facilitating operational and safety policy discussions. HART O&M reviews Project documents, capital construction, Memoranda of Understanding, and third-party agreements to ensure operability and maintainability and provides additional Project oversight and consultation to Project teams. HART O&M is also committed to maintain system assets in a State of Good Repair and provide analytics to prioritize maintenance activities. HART O&M also provides oversight of the Core Systems Contractor's O&M mobilization progress.

In order to assist the City in identifying funding sources, HART, in full coordination with DTS and OTS, has put together preliminary cost estimates for the interim and full O&M service periods.

3.3.5 Safety Oversight

The HART Chief Safety and Security Officer leads the HART System Safety and Security Division and is responsible for managing all Project safety and security activities and ensuring all Project safety and security requirements are met. The HART Safety Team has recently completed the annual update of both the Safety and Security Management Plan and the Safety and Security Certification Plan. The updates to those plans reflect HART's commitment to taking a risk-based approach to mitigating hazards which helps ensure the safe and secure design, construction/installation, and operation of the system. These changes will provide more clarity on why an identified hazard should be introduced and tracked to closure. The changes will also provide clearly defined steps for mitigation, verification, and acceptance that the hazard has been reduced to its lowest acceptable level of risk. Starting April 2017, the HART System Safety and Security Division began providing quarterly updates to the HART Board of Directors. The updates will include the status of safety and security certification, a brief summary on important safety and security issues, and activities that may impact the Project schedule and budget. The HART Safety Team will continue to effectively and efficiently manage its resources in support of HART's ultimate goal of delivering a safe and reliable public transportation system to the citizens and visitors of the Honolulu area.

As mandated by Title 49 of the United States Code of Federal Regulations (CFR) Section 633 and Title 29 CFR Sections 1910 and 1926, HART is responsible for ensuring its employees are provided with a safe work environment. Contractors are also responsible for providing their employees, subcontractors, and visitors with a safe and healthy work environment. The federal Occupational Safety and Health Administration measures a safe work environment by comparing the number of recordable incidents to the total hours worked. HART's current incident rate of 0.76 is five times lower than the State of Hawaii average of 3.8 and nearly six times lower than the national average of 4.5. This low incident rate allows HART to take advantage of premium savings in the Owner-controlled Insurance Program, pay lower claim amounts, and maintain the Project schedule and budget.

As Safety Certification is critical to the success of the project, the HART Safety Team works closely with HDOT, who has the approval authority for entry into passenger service, and all of the Project teams to track and verify all safety related requirements. Regular meetings are held with HDOT to keep it informed of all safety activities in progress. The HART System Safety and Security Division will, upon completion, deliver a fully certified system to the HART O&M Division and DTS to begin Revenue Service Operations.

3.3.6 Decision Milestone Matrix

HART is now incorporating a Decision Milestone Matrix that will help to make the necessary decisions to move the Project forward while identifying potential issues, anticipating the deadlines for decisions on the issues, and executing mitigation actions to resolve the issues. Combined with the Risk Management program, the matrix will become a powerful tool in making appropriate project decisions and ensuring that critical issues remain at an elevated level to be reviewed by management for timely and effective decisions. The matrix itself will be owned by the Risk Manager, who will meet with appropriate managers to determine the critical issues that will be in need of decisions and will meet with the Project Director on a weekly basis for a review of the matrix. On a monthly basis, the matrix will be presented to Executive Management and to the PMOC at the PMOC Monthly Progress Meeting. (The Risk Management Program is described in more detail in Section 3.3.3 above.)

4 Cost Reductions and Containment

4.1 Methodology and Approach

HART continues to apply the knowledge gained from having prepared, awarded, and managed eight multi-million, multi-year alternative delivery transit contracts to ongoing and future work. This will become increasingly important as the Project moves into Honolulu's dense urban core. HART's commitment to explore project delivery efficiencies, and all practical cost containment and cost reduction measures through value-engineering and lessons learned, are further described below.

4.2 Project Delivery Efficiencies

HART has consistently sought to apply project delivery efficiencies to design and construction contracts to improve overall Project cost and schedule performance. Some of the areas analyzed by the Project teams include the following:

- Developing a contract packaging strategy to lower costs by increasing competition.
- Moving towards Design-Build procurement and re-packaging where appropriate to lower costs.
- Evaluating an advance utilities construction package for CCGS to get a jump-start on relocation of interfering utilities and remove utility interference risk as much as possible to the follow-on DB contractor for guideway and stations work.
- Revising contract language, in collaboration with various construction and procurement stakeholders, to provide clear direction and minimize disputes.
- Removing non-essential design and construction elements to reduce cost.
- Performing pre-construction Subsurface Utility Engineering (SUE) and geotechnical investigations.
- Reviewing various Project financing options.
- Implementing a Maintenance of Traffic strategy that allows for expedited issuance of Road Use Permits.
- Utilizing precast and offsite fabrication to reduce cost and schedule.
- Utilizing partnering to resolve construction issues in the field.
- Utilizing a Dispute Review Board to minimize or avoid potential impacts and prolonged litigation.

4.3 Value Engineering

The Risk Manager is compiling and updating all value-engineering suggestions from either formal or informal value-engineering studies and all lessons learned from the Project. Refer to Appendix B for cost savings implemented and considered through value engineering.

4.4 Lessons Learned

HART is holding lessons learned workshops approximately twice per year, facilitated by the Risk Manager, to identify any new cost-avoidance opportunities by being mindful of these topics and addressing them appropriately within new contracts. The most recent workshop was held on May 11, 2017, with a focus on right-of-way, Core Systems interface, utilities, schedule incentives, and how top risks are covered in RFPs. Refer to Appendix B, Exhibit B-1, for the current list of lessons learned.

HART is exploring other opportunities for cost containment and cost reduction as detailed below.

4.5 Soft Costs

HART has undertaken a review of its consultants to address its soft costs and non-direct construction costs, as suggested by the PMOC. HART is taking steps to evaluate consultant scope, performance, qualifications, and technical competencies. HART will also need to systematically evaluate soft costs in all program areas. Upon completion of the soft cost evaluations, HART will bring recommendations to the Executive Director and CEO and the HART Board of Directors for adoption.

4.6 Peer Reviews

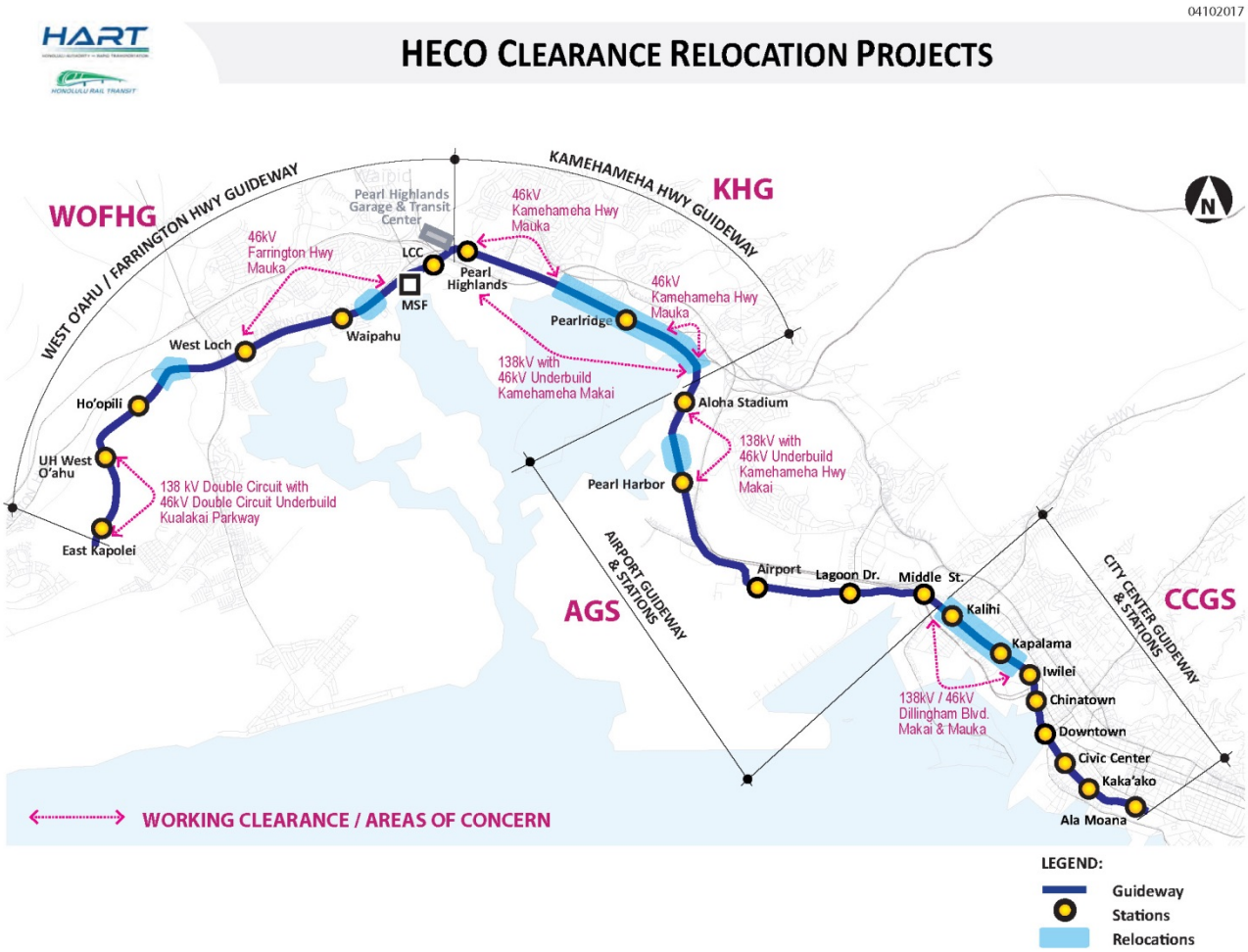
HART has held numerous peer reviews to strengthen the organization by receiving constructive and unbiased feedback from industry leaders. The recent APTA review provided insight with regards to technical management capacity and capability, contract administration and change order process, and claims management. HART has started implementing most of the suggestions from this latest review. The peer review process is on-going and additional reviews will be requested to continue to improve upon HART policies and procedures.

4.7 HECO Utility Relocation and Alternative Equipment

The current system alignment has major impacts on multiple utilities, and HECO in particular has had the most influence on the Project cost and schedule. HECO's self-established clearance requirements conflicted with the construction and operation of the HART system. HART and HECO were able to collaborate and identify alternative equipment (vehicles) to address working clearance concerns between HART's rail guideway and HECO's

high-voltage 138kV transmission, 46kV sub-transmission, and 12kV distribution power lines and associated steel or wood poles. The necessary horizontal working clearances that HECO requires are 50 feet for 138kV power lines, 40 feet for 46kV power lines, and 30 feet for 12kV power lines. Refer to Figure 4-1 below for a map showing the areas of concern.

Figure 4-1: HECO Clearance Relocations



HART has agreed to underground portions of HECO's utility lines, provide HECO funds to purchase the new alternative vehicles, and provide storage space for these vehicles. Because HECO has granted variances to their original clearance requirements in certain areas, the Project can avoid costly overhead and underground utility relocations and save an estimated $138 million. The clearance solutions vary for each section of HART's alignment and are detailed in Appendix I.

The AGS and CCGS contracts both have significant HECO utilities that need to be relocated underground. AGS will use a combination of alternate service vehicles, increased Navy easements, and redesigned (re-framed) pole arms to avoid undergrounding the nine-pole 138kV system fronting Joint Base Pearl Harbor-Hickam. The CCGS design team is in the

review process with HECO to underground all of its utility lines along Dillingham Boulevard. HECO's facilities relocation and coordination with the Project DB contractors remain a high-risk item.

Within the utility-congested City Center section, HART plans to issue an advanced utilities contract to clear the path for the follow-on City Center Guideway and Stations. This advanced utilities contract will be based on unit rates to allow the procurement to proceed in parallel with ongoing utility design activities. This method is intended to expedite the start of utility construction. In addition, since the utility contractor will be compensated based on units of work performed, the parties interests should be aligned to work around and mitigate known risks in the City Center section such as unforeseen utilities, uncertain timing of property access, and inadvertent archaeological discoveries.

4.8 Interim Opening

HART, along with its stakeholders and partners, are currently evaluating the merits of a system interim opening prior to full project completion to the Ala Moana Center Station. An interim opening would be a tremendous opportunity to stress test the system and evaluate performance under reduced service levels and ridership conditions. As detailed below, there is absolutely no difference in the operational readiness and safety requirements for any type of passenger service. HART acknowledges that after several years of interim service, there would be a diminishing benefit in relation to O&M cost and ridership. Thus, the responsible parties must weigh the cost versus benefit as they decide on an interim opening date. Irrespective of the decision to pursue an interim opening, HART intends to be ready to operate and maintain a system from East Kapolei to Aloha Stadium at the end of 2020.

4.9 Cost Containment and Cost Savings Evaluations

The figures below identify potential cost saving opportunities for the Project. A complete list of cost reductions and cost containment items is provided in Appendix B.

Figure 4-2: Project Scope Change Cost Savings

Primary / Secondary	Scope Change Concept	System wide Potential Savings	Design / Schedule Impacts
Primary	Construction Camera Surveillance	<$1M	Minor
Primary	Eliminate landscaping	<$1M	Minor
Primary	Maintain overhead utilities wherever possible	$30M - $200M	Very Significant
Secondary	Pearl Highlands Garage & Transit Center	$25 to $90 M	Significant
Secondary	Core Systems - Electrical Power Backup	$12 M	
Secondary	Eliminate Generators (4)	$8M	
Secondary	Consider center platform and straddle bent design at Chinatown through Kaka'ako	$5M - $10M	Very Significant
Secondary	Reduce aesthetic treatments	$5M - $10 M	Significant
Secondary	Reduce plaza areas	$5M - $10M	Significant
Funding	Eliminate three cross-overs	$2 M	Minor
Secondary	Simplify either Iwilei or Chinatown Station construction (due to proximity)	$1M	
Funding	Funding - Look at alternative funding sources for "complete streets" and non-motorized mobility		
Secondary	Procure more extensive mapping of existing utilities	$100 M	Significant
Primary	Shift Guideway on Dillingham to Makai Side	$50M	Very Significant

Figure 4-3: Potential Cost Reductions

ITEM	DESCRIPTION	POSSIBLE SAVINGS
Interim Opening	Eliminate Interim Opening (per year)	$57 million
Eliminate GET	Eliminate GET from Project or at least from contractor mark-up	$5 million
Rights to Transmission of 3rd Party Power Down the Guideway	Bid out rights to use guideway for power transmission	$10 million
Rights to Fiber Optics in Guideway	Bid out rights to use fiber optics in guideway	$10 million
Private Utilties	Utilities to pay for incremental upgrade to their facilities whether it be size, economic life remaining, etc.	$50 million
Bus Facilities	Have other City agencies fund improvements to bus facilities at stations.	$10 million
HDOT	HDOT to pay for all HDOT Department costs	$30 million
HECO	HART is purchasing HECO equipment in lieu of undergrounding electic lines	$125 million
City	City to exempt HART from GET for leased precast yard	$2 million

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5 Fulfillment of FFGA Scope

5.1 Project Progress and Current Status

The System is scheduled to open for passenger service on December 31, 2025, with a total cost of $8.165 billion. The total cost includes contingency but does not include financing, which is discussed in detail in Chapter 6. The Master Project Schedule shows 355 days of schedule contingency.

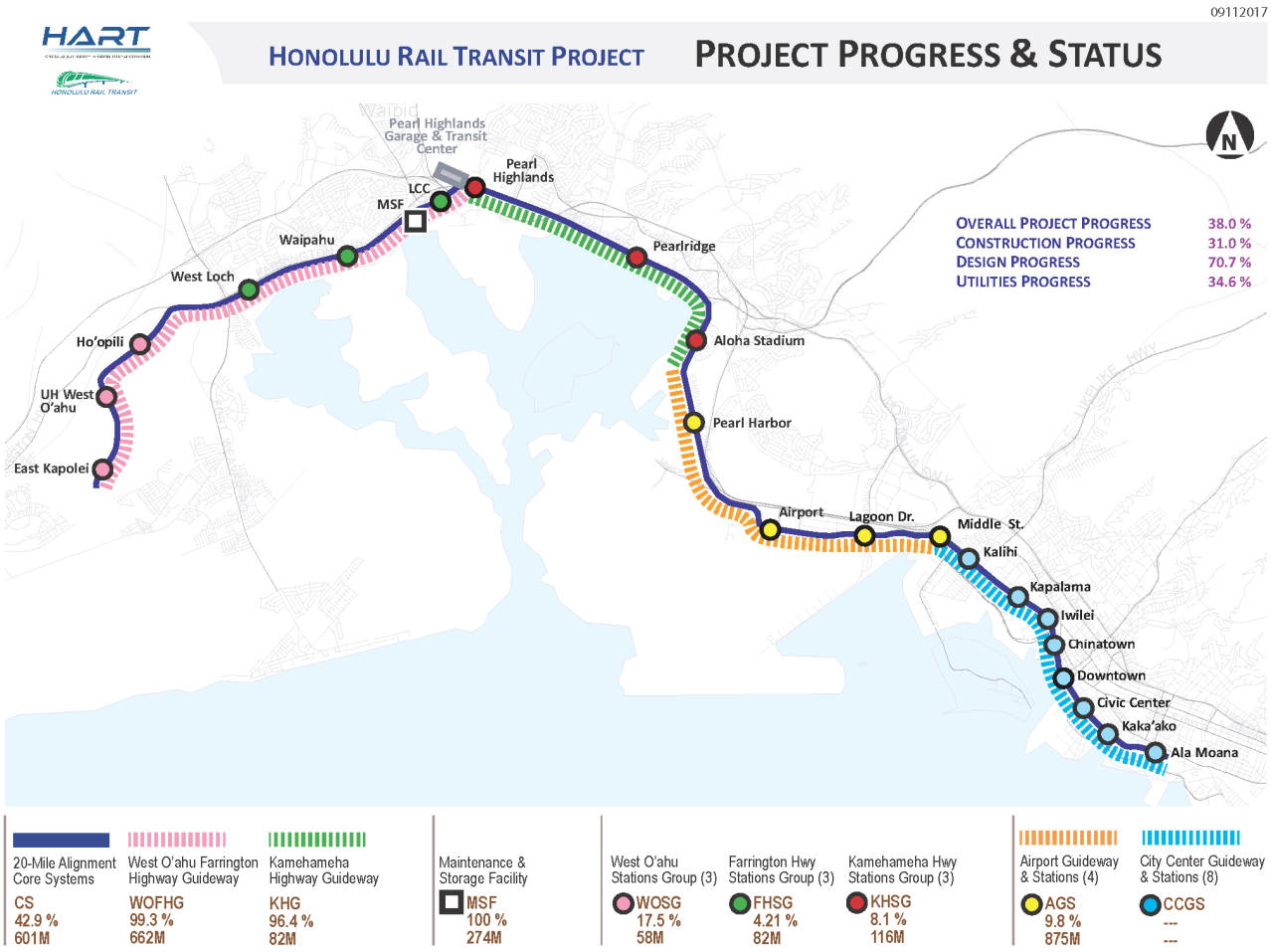
The Project is currently 38% complete based on the weighted value progress of the individual construction and design contracts as of August 2017, which includes completion of the ROC and 10.75 miles of elevated guideway constructed from the East Kapolei Station site to just past the Aloha Stadium Station site. The Project team is working to transition to an earned value calculation based on construction progress and not based on weighted expenditure calculation of the individual design and construction contracts.

5.2 Major Contract Status

Major contracts that have been awarded and their percentage completion are as follows: West Oahu/Farrington Highway Guideway (99.3%); Kamehameha Highway Guideway (96.4%); Maintenance and Storage Facility (100%); Core Systems (42.9%); and Airport Section Guideway and Stations Group (9.8%). With the recent award of the AGS DB contract, HART currently has over $4.27 billion either completed or under contract, which includes 15.9 of the 20.1 miles of guideway and 13 of the 21 stations.

The Core Systems Contractor scope includes the delivery of Vehicles, Signaling, Traction Electrification, Communications, Passenger Screen Gates, and a fully functioning Operations Control Center. The Communications System and the Passenger Screen Gate System are currently under development and are on track to meet the current Project schedule. The contractor has completed the base design development and is well into manufacturing and testing of all other subsystems. Train #1 (four-car consist) was delivered to the ROC in March 2016. The first two cars of Train #2 arrived in Honolulu in April 2017, and the remaining two cars of Train #2 are scheduled to arrive in May 2018. Dynamic testing on the guideway is expected to begin in the fall of 2017.

Figure 5-1: Project Progress and Status



5.3 Right-of-Way Update

The original ROW plan under the FFGA included the identification of 223 total parcel acquisitions and 112 total relocations. For the west-side sections, the HART ROW Branch has obtained site access for all 48 required parcels and completed all 30 required relocations. HART continues to make steady progress in obtaining the required access and completing necessary relocations for the AGS and CCGS segments.

Across all segments of the Project, HART's ROW scope of work has expanded considerably since its original conception in the FFGA. The Project will require the acquisition of approximately 500 easements, including 246 additional easements for utility relocations, and approximately 30 Temporary Construction Easements (TCEs). The HECO utility relocation and related easements are particularly complicated areas that are currently in work. Construction access is being negotiated for two parcels within AGS and approximately 70 parcels within CCGS. Past experience has shown there can be strong resistance to ROW

acquisitions, and Project staff were instructed to proceed with eminent domain actions on those parcels considered to be problematic.

5.4 Strategic Actions to Expedite ROW Acquisitions

HART recognizes there are significant challenges that need to be addressed to ensure that the project can be delivered as planned. The following actions are being implemented to improve our ability to deliver the ROW properties in the timeliest manner possible.

- Fill vacant positions and increase staffing to meet increased acquisition needs
- Use all available information to act at the earliest possible time and maximize economies of scale where appropriate
- Place priority on obtaining access for construction of temporary utility work
- Engage legal representation for complex/difficult acquisitions early
- Staggering/Phasing of property availability for contractors
- Enforce contractor responsibilities to re-sequence or employ mitigation strategies to avoid delay claims
- Aggressive monitoring of acquisition and relocation activity progress

5.5 Summary of Actions to Completion

5.5.1 Major Contract Procurements

The CCGS DB and the PHGT DB contract procurements are the last major contracts yet to be awarded. The CCGS contract is the critical path for the overall Project and is the last of the major contracts to be procured. The current schedule for CCGS is estimated to be 65 months long, a significant amount of time for a 4.16-mile segment that is evidence of its complexity. Utility relocation is a significant part of the CCGS project in Honolulu's urban core, and HART is proactively performing pre-construction SUE and geotechnical work. These final contracts will also benefit from lessons learned and value engineering described in Section 4.2 above and updates to Project Controls, particularly the robust Project Master Schedule and Risk Assessment.

The sequencing of the guideway construction, which is ultimately decided by the CCGS contractor, will drive the critical path to completion. HART is dedicated to working closely with this future partner to meet the Project's cost and schedule targets.

5.5.2 HECO Coordination

HECO indicated a need in the 2019 timeframe for a new dedicated 46kV substation to feed the ROC due to requirements in HECO Rule 13 for line extensions and substations. A location near the ROC is being considered, and initial planning is ongoing with HECO and LCC. No other substations have been identified by HECO for the Project.

HECO has also informed HART that HECO will not perform utility relocation construction services for the electrical facilities within the Airport and City Center sections, including the Dillingham Temporary Utilities section. HECO had previously performed electrical utility relocation construction work for the western half of the Project at HART's request in order to help reduce and manage cost. However, HECO has indicated that it will not be self-performing any construction work for the remaining AGS and CCGS contracts. According to HECO, this is a result of its resources having become stressed, which would affect its core mission. However, HECO will continue to perform the electrical design. HART will procure the utility relocations construction services. HART will explore alternative and available options to ensure that the current 2025 schedule is not affected.

5.5.3 Casting Yard

On April 19, 2017, the FTA provided conditional approval of HART's acquisition via license agreement of the precast concrete manufacturing yard, identified as Lot 31 of Kapolei Business Park West, Phase I.

HART finalized compliance with the FTA conditional approval on April 20, 2017.

HART is now in the process of executing agreements to assume the current license and secure a new license for the casting yard through November 2022. HART intends to sublicense the casting yard to the AGS DB contractor, Shimmick/Traylor/Granite JV.

The short-term agreement has been signed by both the contractor and the property owner and is with HART for final execution.

5.6 Development of Acceptable Project Cost

5.6.1 Introduction

One of the most critical components of the HART Recovery Plan is the development of a realistic cost estimate for the completion of the full Project scope as set forth in the FFGA, referred to herein as the Estimate at Completion (EAC). In developing the EAC, HART has embraced FTA guidelines and procedures relating to risk assessment, cost mitigation, and estimates of capital cost, as well as cost estimating methodologies well accepted in the construction industry.

In particular, in developing the EAC, HART conducted a process for the identification and categorization of risks (described in Appendix C) and developed the Primary and Secondary

Mitigations (described in Appendix B). The Basis of Estimate (BOE) in Appendix F describes in detail the capital cost estimate methodology and assumptions used to develop the Project EAC.

5.6.2 Cost Estimating Methodology

For awarded construction contracts, the actual values of the contracts were used in developing the EAC. This includes the WOFH, KHG, AGS, and MSF Design-Build contracts; the West O'ahu Station Group (WOSG), Farrington Highway Station Group (FHSG), and Kamehameha Highway Station Group (KHSG) Design-Bid-Build contracts; and the Core Systems Contractor (CSC) Design-Build-Operate-Maintain (DBOM) contract. All bid values were adjusted and sorted by the appropriate Standard Cost Category (SCC) for these estimates. An ICE and Validation Estimate were completed for the CCGS procurement.

Additional data sources used for factoring the EAC included staffing projections; change orders in negotiations with contractors; merit changes under evaluation; known risks with potential cost or schedule impacts; and contingency to account for unknown site conditions, unresolved design or scope issues, market fluctuations, regulatory requirements, and schedule impacts.

5.6.3 Adequacy of Contingency

One of the lessons learned by HART from the earlier stages of the Project is the critical importance of sufficient project contingency to address changing market conditions, the cost impact of schedule delays, and other project risk factors. The FTA places great importance on assuring that the project sponsor maintains adequate contingency levels for various stages of project development, as described in the FTA's Oversight Procedure 40c, Risk and Contingency Review, 11-12. Combining the FTA's guidance with the Risk Management Program described in Section 3.3.3 of this Recovery Plan, the total contingency is $1.1 billion (13% of EAC).

5.6.4 Updated Cost Estimate

The current Capital Cost Estimate is $8.165 billion, exclusive of financing costs, which includes $1.1 billion of allocated and unallocated contingency, all in Year of Expenditure (YOE) dollars. The August 24, 2017, cancellation of CCGS procurement has given HART the opportunity to explore options to optimize cost. Project Controls is in the process of thoroughly analyzing the potential of these opportunities. As this analysis is still in process, the current Basis of Estimate assumes no change since the previous Recovery Plan submission. A summary of the estimated costs for the Project is provided in the table below:

Table 5-1: Updated Cost Summary

Contract Summary Status	Estimate at Completion
Active Contracts (includes allocated contingency)	$4,129,313,000
Unawarded Construction (includes allocated contingency)	$1,928,548,000
Staff and Consultants (includes allocated contingency)	$1,286,632,000
Completed Contracts	$546,950,000
Unallocated Contingency	$273,641,000
Total Capital Project (excludes finance costs)	**$8,165,084,000**

HART's procedures include periodic updates to the cost estimates for all work, relying in part on the data from previously bid work, to help estimate the cost of remaining work. Furthermore, the Risk Management System provides quarterly updates to all Project risks in order to model the necessary levels of allocated contingency for each contract. This result, supplemented with the level of unallocated contingency shown above, provides HART with a reasonable degree of confidence that the Project will be delivered within the EAC shown in Table 5-1 above. At the time of each quarterly update, if the EAC varies from the value shown above, then HART has the opportunity to either utilize a portion of the unallocated contingency, or to implement aggressive cost containment/cost reduction proposals being monitored by the Risk Manager with input from the Project teams in order to keep the Project on budget.

5.6.5 Range of Finance Costs

The Project financing costs will be determined by the ultimate funding solution. Financing costs will vary based on when additional funding is received, the total amount of debt required, interest rates, and bond maturity. The Project financing is detailed in Section 6.

5.7 Development of Acceptable Project Schedule

HART's success in achieving the updated RSD will depend in large part on the continued use of the MPIS as a forecasting tool rather than a status reporting tool. While this is a recent change in how the MPIS has been used, management attention will be needed in order to maintain this focus across the organization. Project Controls has reached out to the various HART Division Directors for information to populate the MPIS and how their activities relate to procurement, design, and/or construction. Diligent updating of this information is crucial to the success of the MPIS being a useful tool for managing the overall Project activities in order to best manage the Project as a whole rather than localized optimization of each contract.

The MPIS includes activities from HART Division Directors for procurement, environmental actions, and safety and security as well as design, construction, and core systems contracts.

There are major milestones among the construction and systems contracts that provide significant points of interface, referred to as Contractor Access Milestones (CAMs), that define access and cross-contract exchange of design, construction, and operational information. Consideration was given to the constructability of utility relocations, foundations, columns, and guideway erection based on performance metrics, as well as the physical characteristics of the existing built environment. Construction sequences were developed based on a reasonable and prudent approach to construction assuming a balance and flow of crews, crew sizes, and equipment and directional headings to optimize the schedule. The selected contractor(s) may come up with equal or better schemes based on their preferred means and methods and existing operational experience as well as the availability of equipment and labor. A more detailed description of Project schedule development is found in Section 3.3.2.

5.8 Operations and Maintenance for Interim and Full Openings

The Project's O&M Development Team is responsible for developing a safe, secure, convenient, reliable, and clean service to the general public for the 20.1-mile rail system from East Kapolei Station to Ala Moana Center Station. HART O&M is currently developing the policies, procedures, and staffing requirements to successfully operate and maintain the HRTP system as described above in Section 3. During the Interim Service period, HART O&M will also manage the rail system's operations and maintenance contracts, including the Core Systems Contractor, fare-collection system, and escalators and elevators.

The O&M Team will be ready to operate and maintain the system from East Kapolei Station to Aloha Stadium Station for an interim opening in 2020. The O&M Team must meet the same rigorous operational readiness standards and safety requirements for the interim opening as for any level of passenger service. Many of the major start-up costs will still apply to an interim passenger service. The FTA will also require a Transit Asset Management Plan and State of Good Repair reporting for revenue service, which does apply to an interim opening.

The rail system will operate daily from 4 a.m. to midnight and arrive approximately every five minutes during peak travel hours. The O&M Team will adjust headways and operating strategies to reflect forecasted passenger demand. The O&M Team will also coordinate rail schedules with the City bus system and modify service to accommodate special events. The O&M security team will enforce system rules and ordinances, ensure safe travel for patrons, and deter fare evasion. O&M customer service teams will provide information and help to the general public. The O&M Team will also provide fare collection, evaluate revenue generation, and explore TOD opportunities around the system.

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6 Project Finance

This financial plan section discusses the funding sources; capital costs; and risks, uncertainties, and mitigation strategies associated with the 20.1-mile and 21-station elevated rail transit system extending from East Kapolei in the west to the Ala Moana Center in the east. It is organized in the following manner:

- Summary
- Outcome of State and City Funding Legislation
- Financial Plan
- Funding Sources and Forecast Methodology
- Project Capital Plan
- Risks, Uncertainties, and Mitigation Strategies

6.1 Summary

On September 5, 2017, the Governor of the State of Hawaii, David Y. Ige, signed into law Senate Bill 4, 2017 Special Session (SB4), which became Act 1, 2017 Special Session (Act 1), providing additional funding sources to the City and HART to complete a 20.1-mile and 21-station elevated rail transit system extending from East Kapolei in the west to the Ala Moana Center in the east, known as the Honolulu Rail Transit Project. Act 1 authorized an extension of the 0.5% GET surcharge for 3 years from December 31, 2027, to December 31, 2030. Furthermore, Act 1 increased the state-wide TAT by 1.0%, and dedicated the revenues from that increase to the capital costs of the Project.

Act 1 requires the City Council to adopt an ordinance effectuating the 3-year extension of the GET surcharge prior to January 1, 2018. No City Council action is required to effectuate the TAT increase or its disbursement toward the costs of the Project. On September 6, 2017, the City Council adopted Bill 45 (2017), CD1, to extend the GET surcharge to December 31, 2030, and the mayor signed Ordinance 17-48 into law on September 7, 2017.

The salient funding features of Act 1 are summarized as follows:

- Authorizes the City to extend the current 0.5% GET surcharge for 3 years from December 31, 2027, to December 31, 2030.
- Reduces the State's share of the gross proceeds of the 0.5% GET surcharge from 10% to 1% effective September 5, 2017.
- Established a 1% state-wide TAT increase (from 9.25% to 10.25%) beginning January 1, 2018, to December 31, 2030.

- Provides that revenues derived from the GET surcharge on Oahu and the 1% TAT increase are to be used for HART's capital expenditures, excluding HART's operating, administrative, marketing, and maintenance costs.

In total, Act 1 is projected to yield up to $2.509 billion of additional revenue. Assumptions used to derive this amount are discussed later in this Chapter. Table 6-1 below illustrates the additional revenues expected from Act 1.

Table 6-1: Funding Summary

Source	Prior Funding Projections (millions)	Act 1 (millions)	Dollar Amount of Change (millions)	Percent of Change
Actual GET Collections from September 2009 to June 2017	$1,600	$1,600	$0	0%
Projected GET from July 2017 to December 2027	$2,875	$3,162	$287	9.98%
Projected GET from January 2028 to December 2030	$0	$1,111	$1,111	100%
State-wide TAT from January 2018 to December 2030	$0	$1,111	$1,111	100%
Total	**$4,475**	**$6,984**	**$2,509**	**56.06%**

In addition to providing additional funding for the Project, Act 1 includes a number of State oversight provisions:

- Beginning on January 1, 2018, all of the GET surcharge and TAT increase revenues will be deposited into a State special fund known as the Mass Transit Special Fund.
- The State's Comptroller must certify HART invoices as an acceptable use of funds pursuant to Act 1 before the State Director of Budget and Finance will release any GET and TAT in the Mass Transit Special Fund to the City.
- The State's Office of the Auditor will conduct and complete an audit of HART by January 2019. Furthermore, the auditor is required to perform an annual review beginning immediately and ending on December 2031.
- The President of the State Senate and the House Speaker are to each appoint two non-voting members to the HART Board of Directors. The implementation of this provision is under discussion by the State's and the City's attorneys.

6.2 Outcome of State and City Funding Legislation

6.2.1 State Legislature and Governor of the State of Hawaii

As indicated above, following State legislative action in a special session, Governor Ige signed SB4 into law on September 5, 2017, which became Act 1.

Act 1 provides for revenue sources to fund the construction of the Project. More specifically, the act:

- Authorizes the City, which previously adopted an ordinance to establish a 0.5% surcharge on the state GET, to extend the surcharge for three additional years, from December 31, 2027, to December 31, 2030.
- Decreases from 10% to 1% the GET surcharge gross proceeds retained by the State effective September 5, 2017.
- Increases the TAT state-wide by 1%, from 9.25% to 10.25%, beginning January 1, 2018, through December 31, 2030, for the Project.
- Establishes the Mass Transit Special Fund and specifies that the revenues from the GET surcharge and TAT increase be deposited into this special fund for the capital costs of the Project.
- Requires the State Comptroller to verify and certify invoices submitted for the Project.
- Allows the State Director of Finance to disburse moneys from the Mass Transit Special Fund to the City's Director of Budget and Fiscal Services on a monthly basis upon the State Comptroller's certification of HART's invoices.
- Provides that, after September 5, 2017, GET and TAT revenues allocated from the Mass Transit Special Fund cannot be used for the following:
  - Operation or maintenance costs of a mass transit project.
  - HART's administrative, operating, marketing, or maintenance costs.
- Provides that, if a court makes a monetary award to a County due to the State's violation of any state law or constitutional provision relating to the State's deduction and withholding of county surcharge on state tax revenues, then an amount equal to the monetary award shall be deducted and withheld from the tax revenues deposited into the Mass Transit Special Fund and shall be credited as a general fund realization of the State.
- Requires the State Auditor to conduct and complete an audit before January 2019 and to conduct annual reviews of HART.

- Provides for the Senate President and the House Speaker to each appoint two non-voting, ex-officio members to the Board of Directors of HART.

6.2.2 Honolulu City Council and Mayor of the City and County of Honolulu

Following final passage of Bill 45 (2017), CD1, Relating to the Transportation Surcharge, by the City Council, Honolulu Mayor Kirk Caldwell signed into law Ordinance No. 17-48. Ordinance 17-48 extends the county surcharge for 3 years from 2027 to 2030. Additionally, Ordinance 17-48 codifies the prohibitions on the use of the GET surcharge funds established in Act 1 described above.

6.3 Financial Plan

The "Baseline" financial plan presented in Figure 6-1 was prepared using the following assumptions:

- GET revenue projections from July 1, 2017, and TAT revenue projections from January 1, 2018, are based on the September 2017 forecast of the State of Hawaii's Council on Revenues (Revenue Council). Assumptions used are discussed under the Funding Sources and Forecast Methodology section (Section 6.4) below.
- Annual administrative and operating expenditures of HART are funded by the City.
- A combination of General Obligation (GO) bonds and short-term borrowing in the form of Tax-Exempt Commercial Paper (TECP) will be used to partially finance the Project. Projected interest rates used for GO bonds are 4% for fixed rate and 3% for variable rate bonds and TECP.
- Capital expenditures projections are based on contract schedules and milestones.
- Total project capital cost of $8.165 billion, exclusive of finance charges, with full Revenue Service Date (RSD) on December 31, 2025.

Figure 6-1: Baseline Financial Plan

($ in millions)	Fiscal Years																	
	Total	Actuals to 2016	Actual 2017	Est. 2018	Est. 2019	Est 2020	Est. 2021	Est. 2022	Est. 2023	Est. 2024	Est. 2025	Est. 2026	Est. 2027	Est. 2028	Est. 2029	Est. 2030	Est. 2031	Est. 2032
Beginning Cash Balance	$298	$298	$95	$23	$25	$24	$24	$24	$25	$25	$25	$22	$14	$42	$66	$46	$33	$25
Project Funding Sources:																		
G.E.T. Surcharge	$5,873	$1,320	$226	$248	$262	$271	$281	$291	$301	$311	$320	$330	$341	$351	$362	$373	$285	$0
TAT Revenues	$1,111	-	-	29	63	67	71	74	78	82	86	91	95	100	105	111	58	-
Federal Grant	$1,550	569	216	21	229	227	288	-	-	-	-	-	-	-	-	-	-	-
City Subsidy - HART Admin	$160	-	-	20	24	25	26	21	17	12	10	5	1	-	-	-	-	-
All Other	$7	6	1	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Revenue	$8,702	$1,895	$443	$318	$578	$590	$666	$386	$396	$406	$417	$426	$437	$451	$467	$484	$343	$0
Debt Proceeds																		
TECP (net) Max $350 m	$1,864	$0	$130	$182	$302	$250	$250	$249	$251	$250	$0	-	-	-	-	-	-	-
Variable Bonds	350	-	-	350	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fixed Rate Bonds Net of Issuance Costs	2,419	-	-	-	166	256	454	708	357	111	367	-	-	-	-	-	-	-
Total Debt Proceeds	$4,633	$0	$130	$532	$468	$506	$704	$957	$608	$361	$367	$0	$0	$0	$0	$0	$0	$0
Additional Funds	54	-	-	-	-	-	-	-	-	-	-	5	9	10	10	10	10	-
Total Project Sources	$13,389	$1,895	$573	$850	$1,046	$1,095	$1,370	$1,343	$1,004	$767	$784	$431	$446	$461	$477	$494	$353	$0
Project Uses:																		
Construction	$6,134	$1,350	$517	$522	$578	$624	$879	$781	$423	$203	$148	$106	$3	-	-	-	-	-
Design	220	155	10	23	19	4	2	2	2	2	1	-	-	-	-	-	-	-
ROW / Utilities	726	172	19	113	149	111	75	36	36	15	-	-	-	-	-	-	-	-
Program-Wide	449	253	23	21	24	24	24	21	18	17	14	8	2	-	-	-	-	-
HART Administration	274	88	22	23	24	25	26	21	17	12	10	5	1	-	-	-	-	-
Planning	88	79	2	3	2	1	0	0	-	-	-	-	-	-	-	-	-	-
Project Costs	$7,891	$2,098	$593	$706	$796	$788	$1,007	$861	$497	$249	$174	$119	$6	$0	$0	$0	$0	$0
Unallocated Contingency	274		-	-	-	0	16	42	63	63	55	30	4	-	-	-	-	-
Total Project Costs	$8,165	$2,098	$593	$706	$796	$788	$1,023	$903	$560	$312	$229	$148	$10	$0	$0	$0	$0	$0
Debt Service:																		
Principal:																		
Variable Principal	$350	$0	$0	$0	$0	$0	$0	$42	$50	$50	$50	$50	$50	$50	$8	$0	$0	$0
Fixed Principal	2,428	-	-	-	-	-	-	-	13	39	94	196	277	321	437	475	494	83
CP Retirement	1,864	-	50	100	214	250	250	250	250	250	250	-	-	-	-	-	-	-
Subtotal Principal	$4,643	$0	$50	$100	$214	$250	$250	$292	$313	$339	$394	$246	$327	$371	$445	$475	$494	$83
Interest:																		
Variable Interest	$79	$0	$0	$9	$11	$11	$11	$10	$9	$7	$6	$4	$3	$1	$0	$0	$0	$0
Fixed Interest	736	-	-	3	10	24	45	67	78	87	92	87	78	66	51	33	13	2
CP Interest	33	-	2	1	5	5	4	3	5	7	2	-	-	-	-	-	-	-
Subtotal Interest	$848	$0	$2	$12	$25	$39	$60	$80	$92	$100	$99	$91	$80	$67	$51	$33	$13	$2
Total Debt Service	$5,491	$0	$52	$112	$240	$289	$310	$372	$405	$440	$493	$338	$407	$438	$496	$507	$507	$84
City Debt Reserve:																		
Deposit to City Debt Reserve	$283	$0	$0	$30	$11	$19	$37	$67	$40	$15	$65	$0	$0	$0	$0	$0	$0	$0
Release City Debt Reserve	(283)	-	-	-	-	-	-	-	-	-	-	(47)	-	-	-	-	(147)	(90)
City Debt Reserve	$0	$0	$0	$30	$11	$19	$37	$67	$40	$15	$65	($47)	$0	$0	$0	$0	($147)	($90)
Total Project Uses	$13,656	$2,098	$645	$848	$1,047	$1,096	$1,369	$1,342	$1,005	$767	$787	$439	$417	$438	$496	$507	$360	($5)
Net Current Change	($267)	($203)	($72)	$2	($1)	($0)	$0	$1	($0)	($0)	($3)	($8)	$29	$23	($19)	($13)	($8)	$5
Ending Cash Balance	**$31**	**$95**	**$23**	**$25**	**$24**	**$24**	**$24**	**$25**	**$25**	**$25**	**$22**	**$14**	**$42**	**$66**	**$46**	**$33**	**$25**	**$31**

Table 6-2 below summarizes HART's baseline financial plan:

Table 6-2: Baseline Financial Plan

Source	Funding (millions)
Beginning Cash Balance	$298
GET	$5,873
TAT	$1,111
Federal Grant	$1,550
City Subsidy	$160
All Other ($4 million from the American Recovery and Reinvestment Act; the rest from interest income and rent)	$7
Total Funding Sources	$9,000
Additional Funds	$54
Total Sources	$9,054
Capital Expenditures exclusive of Financing	$8,165
Financing Costs	$858
Total Capital Expenditures including Financing Costs	$9,023
Ending Cash Balance	**$31**

6.4 Funding Sources and Forecast Methodology

6.4.1 Oahu GET Surcharge and State-wide TAT

The local funding sources for the Project are as follow:

- A dedicated 0.5% GET surcharge, with the City and HART receiving 99% of the gross GET proceeds effective September 5, 2017. The 99% is an increase from the 90% of gross proceeds from July 1, 2007, to September 4, 2017.
- A dedicated 1.0% of the State-wide TAT, with the City and HART receiving 100% of the gross proceeds beginning January 1, 2018.

Both the GET and TAT expire on December 31, 2030. Both funding sources are deposited into the Mass Transit Special Fund quarterly subject to the oversight provisions described in the Sections 6.1 and 6.2.1 above. However, the State's Director of Budget and Finance has the discretion to disburse these funds monthly, subject to the availability of funds in the Mass Transit Special Fund.

As shown in Table 6-1 in the Summary section above, these funding sources are expected to bring in $6.984 billion to the Project through December 31, 2030, with approximately $2.509 billion in additional funding generated from the provisions of Act 1.

6.4.2 GET Surcharge and TAT Forecast Methodology

6.4.2.1 Current Method

The growth rates used for this financial plan are forward looking (up to 7 years) and based on the State Revenue Council's latest forecast of state general fund tax revenue and growth as detailed by the State Department of Taxation (September 2017, see Figure 6-2). The Revenue Council is a constitutionally mandated body consisting of seven members appointed by the Governor, the Senate President, and the House Speaker. Its revenue estimates are used by the Governor and the State Legislature to prepare bi-annual budgets and appropriations. Deviations from the Revenue Council's estimates must be justified. The Revenue Council meets four times each year to review, establish, and/or revise state tax revenue estimates. Figure 6-2 shows the Revenue Council's Estimates of General Fund Tax Revenues forecast as detailed by the State Department of Taxation. Table 6-3 below summarizes the growth rates through year 2030.

Figure 6-2: Revenue Council Estimated General Fund Tax Revenues

ESTIMATES OF GENERAL FUND TAX REVENUE FROM THE MEETING OF SEPTEMBER 7, 2017: FY 2018 TO FY 2024
Line item projections generated by Tax Research & Planning Office to be consistent with the Council's forecast for the total General Fund tax revenues
(in thousands of dollars)

	BASE		ESTIMATED						
TYPE OF TAX	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**FY 2020**	**FY 2021**	**FY 2022**	**FY 2023**	**FY 2024**
General Excise and Use Tax	$3,206,154	$3,239,225	$3,365,590	$3,484,017	$3,606,528	$3,734,638	$3,864,419	$4,004,304	$4,128,122
Individual Income Tax	$2,116,392	$2,192,341	2,285,253	2,415,567	2,517,342	2,634,487	2,760,243	2,887,921	3,020,250
Corporate Income Tax	$93,036	$76,761	91,257	89,489	103,600	106,104	109,332	111,234	113,502
Public Service Company Tax	$152,760	$122,159	125,861	130,243	134,802	139,471	144,301	149,300	154,471
Tax on Insurance Premiums	$153,173	$164,688	169,774	173,738	177,994	182,731	187,633	192,792	207,425
Cigarette and Tobacco Tax	$83,685	$82,792	83,120	85,101	87,525	90,085	92,806	95,622	98,540
Liquor Tax	$50,590	$51,167	51,677	52,288	52,876	53,447	54,018	54,596	55,181
Tax on Banks and Other Financial Corps.	$12,691	$9,174	8,156	6,505	5,173	4,553	3,848	3,461	16,787
Inheritance and Estate Tax	$49,613	$18,968	19,287	19,659	20,040	20,425	20,817	21,217	21,624
Conveyance Tax	$26,415	$49,737	53,433	57,582	61,983	66,781	71,748	76,952	81,650
Miscellaneous Taxes*	$16,067	$15,845	16,258	16,253	16,247	16,241	16,234	16,228	16,221
Transient Accommodations Tax	$233,781	$292,357	317,103	339,558	360,690	381,629	402,417	423,302	444,633
GENERAL FUND TOTAL	$6,194,356	$6,315,215	$6,586,769	$6,870,000	$7,144,800	$7,430,592	$7,727,816	$8,036,929	$8,358,406
GROWTH RATE	8.0%	2.0%	4.3%	4.3%	4.0%	4.0%	4.0%	4.0%	4.0%

* The figures on this line include penalty and interest charges, fees and license charges from various taxes, and allocations to the General Fund from the environmental response, energy and food security tax.

Table 6-3: Revenue Council Growth Rates

Fiscal Year	GET Surcharge	TAT
2018	3.90%	8.46%
2019	3.52%	7.08%
2020	3.52%	6.22%
2021	3.55%	5.81%
2022	3.48%	5.45%
2023	3.62%	5.19%
2024 – 2030	3.09%	5.04%

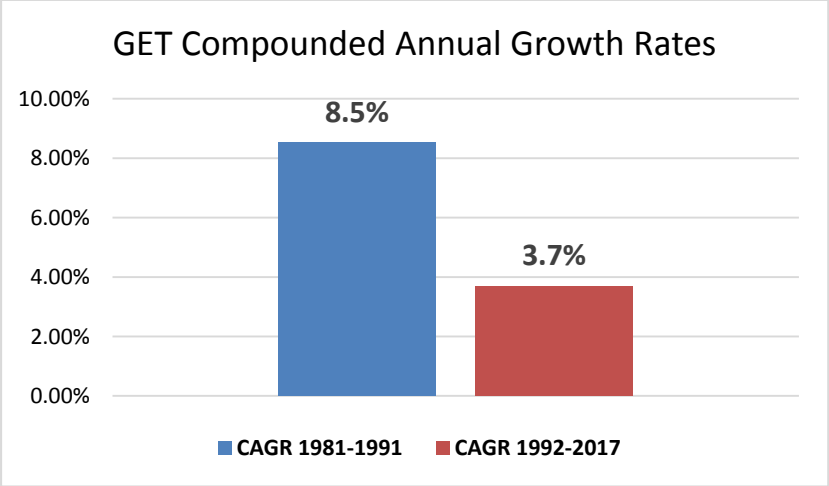
HART used the Revenue Council's growth rate for 2024 to estimate the growth rates from 2025 to 2030. The Revenue Council's forward-looking GET surcharge and TAT growth rates are consistent with the compounded growth rate as discussed below.

6.4.2.2 Prior Method – GET Surcharge

The June 2012 Financial Plan assumed that GET growth would be consistent with the long-term GET CAGR of 5.04% from Fiscal Year (FY) 1981 to FY2010.

Generally, the advantage of utilizing a long-term historical growth average to forecast revenues is that it spans several business cycles, thereby normalizing extreme high- and low-growth years. However, the period used in the 2012 Financial Plan included sustained high inflationary years in the 1980s and early 1990s. Figure 6-3 below highlights the change in the CAGR from 1981–1991 compared to 1992–2017. The CAGR experienced since 1992 (3.7%) is less than half the growth rate experienced over the preceding 10-year period (8.5%).

Figure 6-3: GET Comparison, 1981–1991 vs. 1992–2017



Given the wide variance in the CAGR, the 5.04% growth rate assumed at the time of the 2012 Financial Plan has been changed a number of times since then, to lower numbers reflecting actual growth rates of the GET surcharge collections, as shown in Table 6-4 below.

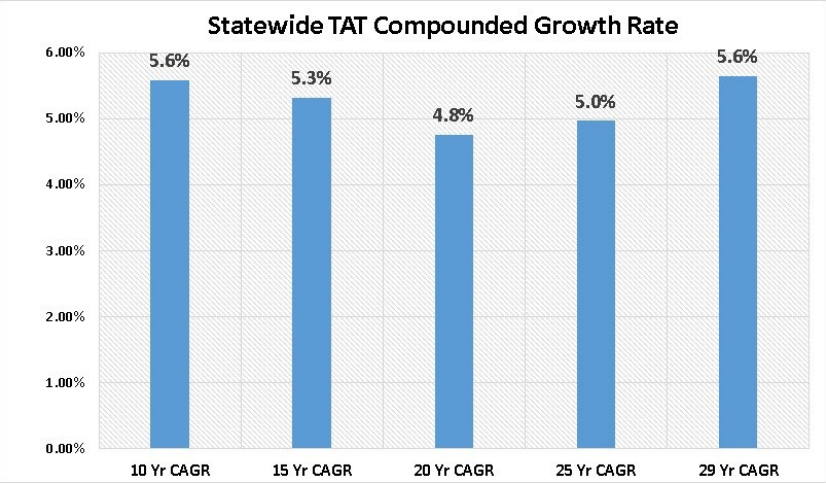
Table 6-4: Project Forecasted Growth Rates

Month and Year	Growth Rate Forecast
July 1, 2012	5.04%
March 31, 2015	4.75%
September 30, 2015	4.00%
March 1, 2016	4.30%

6.4.2.3 Transient Accommodation Tax

The projected TAT growth rate is based on the most recent Revenue Council's State General Fund Tax Revenue forecast (September 2017, see Figure 6-2). The Revenue Council's growth rates are consistent with the historical CAGR when adjusted for increases in the TAT tax rate. As shown in Figure 6-4 below, the CAGR has been relatively consistent over various time intervals. The CAGR based on the Revenue Council's forecast is 5.4%.

Figure 6-4: State-wide TAT Compounded Growth Rate



6.4.2.4 Conclusion on Revenues Forecast Methodology

The Revenue Council's forecast is an objective method for projecting GET surcharge and TAT revenues, embodied in the State Constitution. The Revenue Council's forecast provides for timely updates to changes in the economy and is consistent compared to the GET and TAT CAGR since 1990 as well as variances in more recent CAGR periods.

6.4.3 Federal Funding

The City received a total of $806 million of the $1.550 billion New Starts funding from the FTA through July 2017. The remaining $744 million is awaiting FTA award. This updated financial plan estimates the next incremental award of approximately $229 million will be released around July 1, 2018, with the remaining balance to be disbursed through 2021. No additional FTA grant funding is considered in the financial plan.

6.4.4 City Subsidy – HART Administration

As discussed in the Summary section, Act 1 prohibits the use of revenues derived from State tax revenues (GET and TAT) for HART annual administrative and operating expenditures. This updated Financial Plan assumes that these restricted expenditures that may not be paid from GET or TAT revenues correspond to HART's annual operating budget reflected in Figure 6-1 as HART Administration under Project uses. Accordingly, this updated Financial

Plan is based upon funding from the City in the amount of HART's projected annual operating budgets for FY2019 to FY2027, as well as partial funding for FY2018. Additionally, the City recognizes that additional funds, beyond the amounts projected for HART's annual operating budgets, may be required to complete the Project. To clarify, administrative and operating expenditures of HART are not the same as Operation and Maintenance (O&M) expenditures during revenue operation.

Based upon HART's current and projected annual operating budgets, the estimated amount of City funds required for administrative and operating expenses from the effective date of Act 1 (September 5, 2017) to December 31, 2030, totals $160 million. Table 6-5 below shows HART's estimated administrative and operating expenditures by year, which may require annual City Council appropriation through the annual Executive Operating Budget, by fiscal year. As a result, this updated Financial Plan requires City Council approval. HART will seek to introduce a City Council resolution to approve this updated Financial Plan for City Council action in October 2017.

Table 6-5: Estimated City Subsidy – HART Administration

Fiscal Year	Amount (millions)
2018	$20
2019	$24
2020	$25
2021	$26
2022	$21
2023	$17
2024	$12
2025	$10
2026	$5
2027	$1

6.5 Project Capital Plan

The Baseline Project costs are shown below in Table 6-6.

Table 6-6: Baseline Project Costs

Description	Amount (millions)
Capital Cost	$8,165
Financing and Issuances Costs	$858
Total	**$9,023**

6.5.1 Capital Cost

The baseline project costs below include executed contracts totaling approximately $4.4 billion (53.89% of total project cost below) with approximately $2.8 billion paid to date. Two major construction contracts remain to be procured: CCGS and PHGT.

Table 6-7: Baseline Project Costs

Cost Summary	Estimate at Completion
Construction (SCC 10 to SSC 50)	$ 5,238,076,258
ROW (SCC 60)	263,522,643
Vehicles (SCC 70)	211,661,870
Professional Services (SCC 80)	2,178,152,556
Unallocated Contingency	273,641,000
Total Capital Project (excludes finance costs)	**$8,165,084,000**

On August 24, 2017, the CCGS solicitation was canceled due to developments affecting the qualifications of two priority-listed offerors, desired modifications to the scope of work, and the intent to further enhance competition. The impact of this cancellation to capital cost and project schedule is discussed below in Section 6.6, Risks, Uncertainties, and Mitigation Strategies.

6.5.2 Capital Cost Financing

The financing plan for the Project was developed to (1) preserve the City's financial condition, (2) minimize finance charges, and (3) repay debt service solely from Project revenues by FY2030.

In the years in which capital expenditures are greater than the funding available, a combination of GO bonds (to be repaid by Project revenues and other funding sources) and short-term borrowing (up to a 270-day revolving basis) in the form of TECP will be used. HART and the City entered into a Memorandum of Understanding on May 7, 2015, which was amended and restated on July 26, 2017 (as amended and restated, the "MOU"), The MOU provides, among other things, that HART is required to deposit into the City's general fund a debt reserve equal to the lesser of 10% of the par value of the outstanding bond amount or 50% of the maximum annual debt service on all outstanding bonds. This financial plan anticipates the release of the debt reserve to partially fund debt service in 2026, 2031, and 2032. On September 6, 2017, the City successfully sold $350 million of variable rate GO bonds to partially meet HART's FY2018 cash needs.

The financial plan assumes interest rates of 4.00% for fixed rate GO bonds and 3.00% for variable rate GO bonds. The rates used are based on the City's current AA+ rating. The interest rate used on TECP is at 3.00%. The variable rate bonds sold on September 6, 2017, described above, carry an initial variable interest rate of Securities Industry and Financial

Markets Association (SIFMA) plus 30 to 32 basis points (approximately 1.1%) adjusted weekly.

Issuance costs of debt are estimated at 0.40% of gross GO bond proceeds and the TECP line of credit.

The City's financing requirements are presented in Figure 6-1, under Debt Financing Summary. In summary, GO bond proceeds amount to $2.769 billion, with TECP revolving borrowings at $1.864 billion (maximum limit of $350 million outstanding). All debts will be repaid by FY2032.

6.6 Risks, Uncertainties, and Mitigation Strategies

The sections above focus on discussions surrounding the baseline financial plan and assumptions. This following discussion emphasizes the risks and uncertainties, including mitigation strategies, on key assumptions.

6.6.1 Capital Plan

6.6.1.1 Project Costs

This section discusses potential risks associated with the CCGS, utility installation and relocations, and ROW acquisition and relocations.

- **CCGS:** As discussed above, after an extended suspension, on August 24, 2017, the CCGS solicitation was canceled due to various developments which made it prudent to re-solicit the project. The impact of this cancellation on capital cost and project schedule is under evaluation. There is a potential risk of construction escalation and related additional soft costs if mitigation strategies do not materialize. HART is using this opportunity to explore other contract delivery options with the objective of reducing costs and shortening the Project schedule. HART is also reviewing an advanced utilities contract to clear the path for the follow-on CCGS contract. This advanced package could mitigate schedule delays and reduce unforeseen risks in the CCGS contract. However, there is also a risk that a separate utilities contract package could increase the "soft" costs due to some additional construction management and administration costs.

  Additionally, a viable option may be a Public-Private Partnership (P-3). In recent years, P-3s have been employed in a number of projects around the country with positive results (savings between 15% to 25% as documented in the March 7, 2017, ulupono report). Coincidentally, the FTA recently proposed new rules encouraging private investments in public transportation projects. The City and HART have held preliminary discussions with the private sector. In addition to the potential savings, other benefits could be innovation brought to the Project; long-term risk transferred

to the private sector; increased cost and schedule certainty; increased public confidence in the Project; and construction acceleration.

HART is in the process of bringing on board a P-3 Advisor to perform an overall viability assessment, for the use of the P-3 delivery approach to the CCGS and the PHGT projects, as well as to help develop the most optimal model of P-3 that could be used. HART, in conjunction with the P-3 Advisor, will perform a Market Sounding to assess the interest of the private sector in participating in these projects.

- **Utilities:** Utility installations/relocations represent another significant cost component as the Project moves into the more congested City Center segment. The Project has major impacts on multiple utilities, with electrical infrastructure owned by HECO having the greatest impact on cost and schedule. Utility relocations along Dillingham Boulevard are on the critical path and will require in-depth utility design work to provide for the needs of the system and address HECO electrical clearance issues. To mitigate the risk, HART is proactively performing preconstruction subsurface utility engineering and geotechnical work. HART is also advancing the utility relocation package to a fully signed and sealed document for bids. This action will minimize cost and schedule risks assigned to this project.

- **ROW:** HART acknowledges that the Honolulu real estate market is robust, which increases HART's financial and legal risks regarding ROW acquisitions and relocations. These risks have not yet been fully captured in existing risk assessment models. Many of these risks relate to the wide range of possible jury verdicts with regard to property valuations in eminent domain trials. However, given the sometimes unpredictable and uncontrollable results of jury verdicts in eminent domain trials, HART believes it most prudent to disclose the potential for risk in excess of budgeted amounts in the updated financial plan.

  HART has determined that a full re-assessment of its total allocated and unallocated risks for the entire Project, inclusive of ROW risks, needs to be performed at this time and has kicked off a series of workshops to this end. By fully assessing both risks and opportunities, by and recognizing that a substantial portion of the work has already been completed, HART is confident that its current contingency budget will be adequate to cover remaining risks on the Project.

In summary, HART has a robust risk management program and is committed to enacting cost containment measures as a primary tool to maintain the Project's capital cost and schedule within the established budget.

If needed, HART also has a number of strategies to mitigate these downside risks, including:

- Additional debt capacity available to the City through the issuance of GO bond debt.
- Utilize the existing TECP bond program for short-term financing needs.

- Reducing HART's expenses and Project costs (for example, through private-public partnerships).
- Extending local revenue sources such as City subsidies, which will require City Administration and City Council approval.

Additional State funding sources, such as additional GET surcharge and TAT revenues, are another possible additional source of funds, but they will require further State legislative enactments.

6.6.1.2 Interest Rates and Municipal Market

There are inherent risks associated with interest rates and access to Municipal Market with capital projects requiring financing. Interest rate volatility as a result of monetary policies, geopolitical events, economic activities, etc., can impact Project cost. In a rising rate environment, additional revenues are used to pay financing costs. As a result, borrowings will increase to replace the revenue reserved to pay for capital expenditures.

To mitigate interest rate risk, the financial plan uses an average 4% rate for fixed-rate debt and 3% for variable-rate debt. The average rates used are approximately 1% to 2% higher than the current market rate.

6.6.2 Revenue and Funding Risks

6.6.2.1 GET Surcharge and TAT Revenues

The baseline financial plan utilizes the most current forecast by the State Revenue Council. However, actual collections may come in lower than the forecasts depending on (1) a number of underlying economic factors outside of the Project's control, and (2) the Department of Taxation's GET tax surcharge processing fluctuations. Temporary revenue instability can be covered by TECP. Prolonged downturns in actual revenue collections may require long-term solutions as described above.

6.6.2.2 Federal Grant Revenues

The updated baseline financial plan assumes authorization by the FTA to drawdown on the remaining $743 million commencing in July 2018. Should the authorization occur later than July 2018, additional debt may need to be issued to balance Project costs. Future debt requirements would be reduced once the authorization is granted and drawdowns resume. As an example, an authorization and disbursement of $100 million by December 2017 would result in up to $16 million in interest savings.

7 Operating Plan

This Operating Plan section discusses the integration strategies for bus and rail operations and service during the interim revenue service opening scheduled for December 2020 and the full revenue service opening scheduled for 2025. It is organized in the following manner:

- Introduction
- Bus Operations and Planning for Rail Service
- Operating Plan as submitted to FTA on December 1, 2016

7.1 Introduction

DTS, in collaboration with HART, is actively working on an integrated transportation plan in preparation for interim revenue service scheduled for December 2020 and full revenue service scheduled for December 2025.

As of July 1, 2017, Charter Amendment 4 revised the City Charter to transfer operations and maintenance responsibility for rail from HART to DTS to leverage operations efficiencies within the multimodal rail, bus, and paratransit system under the leadership of a single entity. Furthermore, Charter Amendment 4 established a Fare Commission to annually review bus, paratransit, and rail fares. The Fare Commission is set to hold its first meeting in October 2017. In anticipation of this effective date, operations and leadership teams from DTS and HART have convened regular meetings to establish a road map and paths to integration, transfer, and establishment of an efficient operations and maintenance structure for the evolving rail project. The coordination will result in a detailed organizational chart which will clearly delineate roles, responsibilities, and fiscal impacts for future funding of positions, some which may transfer from HART to DTS at appropriate times pending rail segment completion and opening.

This document contemplates the complete transfer of operations and maintenance responsibilities from HART to DTS to coincide with planned full revenue service rail opening scheduled for 2025. Therefore, interim operations milestones pertaining to bus and paratransit including initial interim opening between the East Kapolei and Aloha Stadium Stations, the potential extension of the interim segment to Middle Street Station, and full revenue service of the complete 20.1-mile, 21-station alignment will be detailed in the narrative below.

7.2 Bus Operations and Planning for Rail Service

This section details the planning and implementation strategies to fully integrate bus (TheBus) and paratransit (TheHandi-Van) with rail as constructed segments are opened and become operational.

Any proposed changes to existing service will involve a public review process.

7.2.1 Interim Opening 1 – East Kapolei Station to Aloha Stadium Station

The planned interim opening to revenue service in December 2020 between East Kapolei and Aloha Stadium Stations (a total of nine stations) represents approximately half of the 20.1-mile full rail alignment. It is a short-term opportunity to improve mobility within West and Central Oahu; however, since it does not yet enter the urban Honolulu boundary, planned service changes for the bus will be limited to reconfigurations of existing local services and neighborhood circulators to incorporate the nine rail stations. Regional express routes and trunk routes providing service between West and Central Oahu will mostly remain intact until approaching full revenue service when rail enters urban Honolulu.

Successful operation of this segment will enhance the public image and the value of rail transit to the island economy and may gain support for the east (University of Hawaii at Moana) and west (West Kapolei) extensions of the rail alignment as envisioned in the EIS.

7.2.1.1 East Kapolei Station

Current hub-and-spoke bus networks in Ewa and Kapolei will be realigned to provide service to this station as well as the neighboring UH West Oahu Station. A 900-parking-space park-and-ride facility is planned as part of the station site.

Existing trunk, regional rapid service, and peak-hour expresses will continue to operate. Community circulator routes will connect this station to the neighborhoods of Makakilo, Villages of Kapolei, Kapolei Hawaiian Homesteads, Kalaeloa, Ewa Villages, Ewa Gentry, Ocean Pointe, Hoakalei, and Ewa Beach.

Moderate service increases are planned for realignment of the current route network and increases in spans of service. DTS, in coordination with HART, is currently planning and designing rail station access pedestrian crossing infrastructure to connect this station to public properties across the major highway-speed state roadway.

7.2.1.2 UH West Oahu Station

Current hub-and-spoke bus networks in Kapolei will be realigned to provide service to this station as well as the neighboring East Kapolei Station. A 1,000-parking-space park-and-ride lot is planned as part of the station site.

Existing trunk, regional rapid service, and peak-hour expresses will continue to operate. Community circulator routes will connect this station to the neighborhoods of Makakilo, Villages of Kapolei, Kapolei Hawaiian Homesteads, Kalaeloa, and Hoopili.

Moderate service increases are planned for realignment of the current route network and increases in spans of service.

7.2.1.3 Hoopili Station

Hoopili Station will be constructed before its surrounding TOD principled neighborhood, which is expected to develop concurrently around the station through 2030. A planned temporary park-and-ride will offer commuters the option to use rail as an alternative to using the parallel H-1 Freeway.

No additional service is planned for the interim opening, although existing trunk routes will be able to accommodate the new neighborhood until more density is imminent.

7.2.1.4 West Loch Station

Current hub-and-spoke bus networks in Waipahu already support this station location. Existing trunk, regional rapid service, and peak-hour expresses will continue to operate. Existing community circulator routes will connect this station to the neighborhoods of Royal Kunia, Village Park, and West Loch Estates.

Moderate service increases are planned for increased frequency on existing routes and increases in spans of service.

7.2.1.5 Waipahu Transit Center Station

Current hub-and-spoke bus networks in Waipahu already support this station location via an existing major transit center and transfer point. Existing trunk, regional rapid service, and peak-hour expresses will continue to operate. Existing community circulator routes will connect this station to the neighborhoods of Royal Kunia, Village Park, Robinson Heights, Waipahu, Waikele, Seaview, Crestview, and Waipio. New service will extend to the new Koa Ridge neighborhood.

Moderate service increases are planned for extended service, increased frequency on existing routes, and increases in spans of service.

7.2.1.6 Leeward Community College Station

A single existing community circulator will connect this station to the Pearl City and Pearl City Peninsula neighborhoods.

No increases in service or service span are planned for this phase.

7.2.1.7 Pearl Highlands Station

Existing trunk and regional rapid services will continue to operate and serve this station. A 1,600-parking-space garage with dedicated regional freeway interfaces and a major bus transit center is planned as part of the station site but will not be available for interim opening.

No increases in bus service are planned for this station for this phase. DTS, in coordination with HART, is currently planning and designing rail station access pedestrian crossing infrastructure to connect this station to public and private properties across the adjacent major State-owned Kamehameha Highway.

7.2.1.8 Pearlridge Station

Existing trunk and regional rapid services will continue to operate and serve this station. Planning is underway for the construction of an adjacent bus transit center. Current peak-hour community circulator routes will be realigned and service spans extended to support this station.

Moderate service increases are planned for extended service, increased frequency on existing routes, and noted increases in spans of service.

7.2.1.9 Aloha Stadium Station

Existing trunk and regional rapid services will continue to operate and serve this station. A 600-parking-space park-and-ride lot and a major bus transit center will be constructed as part of this site. Current peak-hour community circulator routes will be realigned and service spans extended to support this station.

Since this station currently serves as the interim east-end terminus of the rail alignment as construction commences eastward to the final planned terminus at Ala Moana Center Station, major service increases are planned for extended service, increased frequency on existing routes, and noted increases in spans of service. These services will include new frequent peak-hour expresses and all-day regional rapid services between Aloha Stadium Station and major commuter destinations including Downtown Honolulu, UH Manoa, Waikiki, and East Honolulu. These new services will operate until further rail extensions are opened for operations, at which time they will cease and be restructured and reallocated.

7.2.2 Interim Opening 2 – Eastward Extension from Aloha Stadium Station to Middle Street Station

A potential second interim opening near 2023 could extend the initial interim segment approximately 5 miles and three stations beyond the Aloha Stadium Station to the Middle Street Station via the Honolulu International Airport. This is the rail operational alignment's first entry into the urban core of Honolulu and provides the additional benefit of interfacing directly with the Honolulu International Airport. At this point, however, the operating

alignment still does not reach the highest density of riders in urban Honolulu near the Downtown Station and the planned terminus at Ala Moana Center Station. Connecting bus networks will be adjusted accordingly during this phase but will not reach final major changes until the full operational line is completed.

7.2.2.1 Pearl Harbor Station

Existing trunk and regional rapid services will continue to operate and serve this station. This station lacks space for an adjacent transit center to facilitate bus transfers to the nearby Pearl Harbor Naval Shipyard and the Joint Base Pearl Harbor-Hickam. Transfers to bus will occur at the neighboring Aloha Stadium Station.

No increases in service are planned for this station except for related frequency and span of service costs incurred at neighboring stations that are serviced by the same trunk and regional rapid services.

7.2.2.2 Airport Station

Existing trunk services will continue to operate and serve this station. A small-scale transit center is integrated into the design of this station site. Some trunk routes servicing the airport will be restructured into community circulator routes with extended service spans to connect this station to the Makalapa, Aliamanu, Salt Lake, and Moanalua neighborhoods.

Moderate service increases are planned for restructured and extended service, increased frequency on existing routes, and increases in spans of service.

7.2.2.3 Lagoon Drive Station

No current existing services operate in the area of Lagoon Drive Station; however, new services are planned to connect community circulators to the station with a collaborative planning effort between DTS, HART, and the State Department of Transportation to plan, design, and construct a bus turnaround loop for new routes serving the Lagoon Drive Station. These circulators will connect the Lagoon Drive station to the Airport Industrial Area as well as the Salt Lake, Moanalua, Mapunapuna, and Kalihi neighborhoods.

During the proposed interim extension to Middle Street, former new frequent peak-hour expresses and all-day regional rapid services operating between Aloha Stadium Station and major commuter destinations including Downtown Honolulu, UH Manoa, Waikiki, and East Honolulu will be discontinued at Aloha Stadium Station and implemented at Lagoon Drive station for convenient access to the H-1 Freeway. Major increases are planned for new services, increased frequency on existing routes, and increases in spans of service. Although this is the penultimate stop in the interim extension, it is the most practical location to transfer to and efficiently route connecting rail-access services. These services will operate until the final opening of full rail operations to Ala Moana Center Station, at which time they will cease and be restructured and reallocated.

7.2.2.4 Middle Street Station

Middle Street Station will connect directly to the Kalihi Transit Center, the largest bus transit center in urban Honolulu. Major trunk and regional rapid services will continue to operate and serve this station, with high-frequency routings and a large number of originating and ending trips. Community circulators will be implemented to connect with Kalihi Uka, Kalihi Waena, and Kalihi Kai neighborhoods. Restructured service to and from Windward Oahu will interface with rail at the Middle Street Station.

Major service increases are required for bus routes at this station as well as to increase capacity and frequency on existing urban Honolulu corridor trunk routes to anticipate and afford capacity with the overlay of the high-capacity rail operations connecting to the existing bus network.

7.2.3 Full Opening – East Kapolei Station to Ala Moana Center Station

The full opening of rail to service the entire planned 20.1-mile, 21-station corridor represents the largest-scale implementation and revision of connecting bus and paratransit operations. Peak-hour express routes to the entire island of Oahu excepting Windward and East regions can be scaled back and converted to high-frequency peak-hour services which interface to the rail alignment. This potential savings in bus operating expenses can be applied to creating better connections at all stations, emphasizing *mauka-to-makai* (inland to ocean) bus route alignments that connect at rail stations. All neighborhood community circulator connections in previously-detailed station-based plans will be revised and adjusted according to new projected demand for services. The following summarizes station-based changes for the new stations coming online.

7.2.3.1 Kalihi Station

New trunk, regional rapid, and community circulator services connecting to Kalihi Uka and Kalihi Kai will be implemented to serve this station. Moderate service increases are planned for all new routes and increases in spans of service.

7.2.3.2 Kapalama Station

New trunk, regional rapid, and community circulator services connecting to Kamehameha Heights, Alewa Heights, and Kalihi Kai will be implemented to serve this station. Moderate service increases are planned for all new routes and increases in spans of service.

7.2.3.3 Iwilei Station

New trunk, regional rapid, and community circulator services connecting to Liliha and Nuuanu will be implemented to serve this station. Moderate service increases are planned for all new routes and increases in spans of service.

7.2.3.4 Chinatown Station

Existing and new trunk and regional rapid services will be continued and implemented to serve this station. Moderate service increases are planned for all new routes and increases in spans of service. DTS and HART are collaboratively planning major pedestrian access infrastructure to improve rail and transit access to the station.

7.2.3.5 Downtown Station

Existing and new trunk and regional rapid services will be continued and implemented to serve this station. Moderate service increases are planned for all new routes and increases in spans of service. This station does not have adequate space for an adjacent bus transit center. Major transit connections will be made at the neighboring Civic Center Station.

7.2.3.6 Civic Center Station

Services from Windward Oahu will terminate at the Civic Center Station in Kakaako. New trunk services will be implemented to serve this station. Community circulator services connecting this station to Pacific Heights, Pauoa, Papakolea, and Makiki will also be implemented. Additionally, rapid bus services to connect this station to Ala Moana, Waikiki, UH Manoa, and East Honolulu will be installed.

Major service increases are planned for all new routes and increases in spans of service. DTS is planning a transit mall and on-street transit center for this station, as well as related dedicated pedestrian and cycle track infrastructure.

7.2.3.7 Kakaako Station

Community circulator services connecting this station to Makiki will be implemented. Moderate service increases are planned for all new routes and increases in spans of service.

7.2.3.8 Ala Moana Center Station

Major existing trunk routes will see service frequency and span increases. Additionally, rapid bus services to connect this station to Waikiki, UH Manoa, and East Honolulu will be implemented with community circulators connecting this station to Makiki, Manoa, and Moiliili. Major service increases are planned for all new routes, and increases in existing frequencies and spans of service. DTS is planning two bus transit centers adjacent to the station to facilitate anticipated high rates of transfers and pedestrian walk-up passengers. A major bus rapid transit project is planned to connect the terminus of the rail alignment to the high population- and job-density destination of Waikiki.

7.3 Operating Plan as Submitted to FTA on December 1, 2016

As stated in the prior sections, the detailed planning for the integrated transportation system has begun and will continue to be refined over the next several months. Ultimately, any proposed changes to existing service will involve a public review process. The Operating Plan will be continuously updated to reflect these detailed operating plans.

The following section is the update to the original Operating Plan (June 2012) that was transmitted to the FTA on December 1, 2016. The updates include the impacts of the change in interim and full revenue service dates; actual cost escalation rates to date; updated ridership projections; and other operating changes (such as fare gates instead of fare enforcement).

As with the original Financial Plan (June 2012), the updated Financial Plan reflects the current transit policies applied to the future integrated transit system. The current City policy of setting fare revenue recovery rate is 27% to 33% of operating costs. The current fare rate categories remain constant in the updated Financial Plan. By holding these factors constant, this updated Operating Plan projection will serve as a base comparison for changes to fare policies, fare differentials, and service levels.

7.3.1 Introduction

This report updates the Operating Plan portion of the original City's Final Financial Plan for FFGA, June 2012. This updated Financial Plan is based on the 20.1-mile route with full revenue service starting December 2025. Interim service may begin in December 2020 to Aloha Stadium.

The Project will be fully integrated with TheBus operations, which will be reconfigured to add feeder bus service to provide increased frequency and more transfer opportunities between bus and rail. The new rail and modified bus service will provide additional travel options, increase service frequencies, expand the hours of operation, minimize wait times, reduce total travel times, improve service reliability, and enhance comfort and convenience for passengers.

7.3.2 Update Summary

7.3.2.1 Original Financial Plan

The following table summarizes the financial elements in the original Financial Plan that was released in June 2012. The table compares FY2011 actual with the first full year of operations in FY2020 in inflated YOE dollars.

Table 7-1: Original Financial Plan Figures, June 2012

		FY 2011 Actual	Original FY 2020	Change	% Change
Bus Cost	YOE million $'s	$173	$263	$90	52%
Handi-Van Cost	YOE million $'s	$34	$59	$25	73%
Rail Cost	YOE million $'s	$0	$113	$113	-
Combined Total	YOE million $'s	$207	$435	$228	110%
Bus Service Hours	millions	1.38	1.58	0.20	14%
Fare Revenue	YOE million $'s	$54	$110	$56	104%
Average Fare	YOE $'s	$0.93	$1.30	$0.37	40%
Subsidy	YOE million $'s	$133	$307	$174	131%

7.3.2.2 Updated Operating Costs

Projecting rail operating costs is a two-step process. The first step is to update the operating plan in today's current dollars incorporating all known changes (for example, four-car trains, fare gates, and power consumption estimates). After capturing current real changes, the second step is to convert current year cost figures into YOE dollars by selecting an inflationary factor.

Updated rail costs in current-year dollars are as projected in the original Financial Plan (June 2012). However, projection estimates in certain cost categories vary considerably from the original projections.

These current year cost estimates are then converted to YOE dollars. The original Financial Plan applied various escalation factors to each cost category (for example, core systems, power costs, and station maintenance). This update provides a range of cost escalation scenarios and details their impacts.

Bus costs have been as anticipated in the original Financial Plan. The historical annual increase in bus costs per revenue service hour in the original Operating Plan was 3.9%. The actual cost per revenue hour over the last 10 years is 3.1% reflecting the recent lower fuel prices. The updated Financial Plan estimates bus costs per revenue service hours to increase at approximately the same level as the original Financial Plan's historical cost. Handi-Van has experienced the cost increases as projected in the original Operating Plan.

7.3.2.3 Updated Ridership

Ridership is projected using a travel demand model with inputs from customer survey data. A more robust regional planning model is currently being utilized to forecast ridership in conjunction with a fare modeling study. Approximately 258,000 daily linked trips were estimated in the first full year of a bus and rail combined system in 2020. The forecast grew to 280,000 linked trips per day in 2030 for the bus and rail combined system. The updated forecast estimates approximately 279,000 linked trips in the first full year and 313,000 in the tenth year.

With respect to actual boarding to date, actual boarding and the original Financial Plan forecast began to diverge in FY2013. There are a number of factors that may have contributed to this situation, but service hour reductions and the decreasing price of fuel beginning in May 2014 are likely contributors. The updated ridership forecast commences at the current ridership results from FY2016.

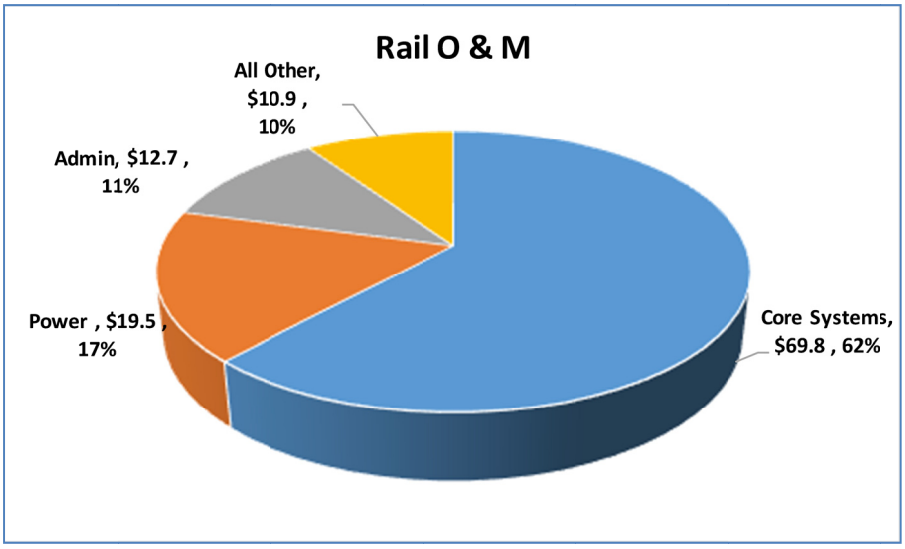
Fare rate increases are comparable to Consumer Price Index All Urban Consumers (CPI-U) increases utilizing the original Financial Plan factors. Similar to the cost scenarios, this Financial Plan also details the impact of lower ridership figures and its impact on fare rates and subsidy levels.

7.3.3 Operating Cost Update

7.3.3.1 Rail O&M Costs

The assumptions incorporated in the original Financial Plan were mostly conceptual, as final designs were not developed by the plan's release in June 2012. This update of rail O&M costs is based on information obtained and project developments between June 2012 and November 2016. These updated figures will be continually reviewed as designs are finalized, operation and maintenance contracts are secured, and organizational structure develops. The following figure reflects the operating costs in the original Operating Plan. Core Systems Contract and power represent nearly 80% of all operating costs.

Figure 7-1: Original Financial Plan Rail Costs in FY2020, YOE Dollars (Millions)



Projecting rail operating costs is a two-step process. The first step is to update the operating plan in today's current dollars including all known contract awards, final designs, system changes such as fare gates and four-car trains, process changes, and energy consumption projections. After capturing current real changes, the second step is to convert current-year cost figures into future YOE dollars.

The following table compares the updated cost estimates to the original financing cost estimate for FY2016. In other words, if the rail systems were opened today, what would the cost be using the contractual cost of the Ansaldo contract, current electrical rates, power consumption estimates, etc. The table reveals that total rail costs in current dollars are approximately as projected in the original Financial Plan. However, deviations exist within the various cost categories. These deviations are explained in the following sections.

Table 7-2: Update of Rail O&M Costs, 2016 Dollars (Millions)

	FFGA First Full Year of Operations, June 2012:					Updated FY 2017:	
	In Constant $'s mil.	FFGA Inflation Factor	Inflated to Cost in FY 2017	Inflated to Cost in FY 2020	Inflated to Cost in FY 2026	Updated Amount in Current $'s	Change from FFGA FY 2017
Core Systems Labor	$ 25.5	1.2%	$ 27.1	$ 27.9	$ 29.9	$ 36.1	$ 9.1
Core Systems Materials	$ 20.2	3.6%	$ 24.1	$ 27.3	$ 34.0	$ 20.5	$ (3.6)
Core Systems Admin	$ 13.1	1.2%	$ 13.9	$ 14.5	$ 15.6	$ 13.9	$ -
Subtotal Core Systems	$ 58.8		$ 65.1	$ 69.8	$ 79.5	$ 70.6	$ 5.5
HART Admin	$ 10.4	2.5%	$ 11.8	$ 12.7	$ 14.7	$ 7.0	$ (4.8)
Power Costs	$ 18.3	0.8%	$ 19.1	$ 19.5	$ 21.8	$ 16.5	$ (2.5)
Guideway Maintenance	$ 1.9	2.5%	$ 2.2	$ 2.4	$ 2.7	$ 2.65	$ 0.4
Security Patrols	$ 0.7	2.5%	$ 0.8	$ 0.8	$ 1.0	$ 2.00	$ 1.2
Fare Enforcement	$ 1.8	2.5%	$ 2.0	$ 2.2	$ 2.6	$ -	$ (2.0)
Fare Collection	$ 2.4	2.5%	$ 2.8	$ 3.0	$ 3.4	$ 3.33	$ 0.6
Station Maint.	$ 2.1	2.5%	$ 2.3	$ 2.5	$ 2.9	$ 2.83	$ 0.5
Water	$ 0.01	2.5%	$ 0.01	$ 0.01	$ 0.02	$ 0.03	$ 0.0
Subtotal HART	$ 37.7		$ 41.0	$ 43.1	$ 49.2	$ 34.3	$ (6.6)
Total Projected O&M	**$ 96.5**		**$ 106.0**	**$ 112.8**	**$ 128.7**	**$ 104.9**	**$ (1.1)**

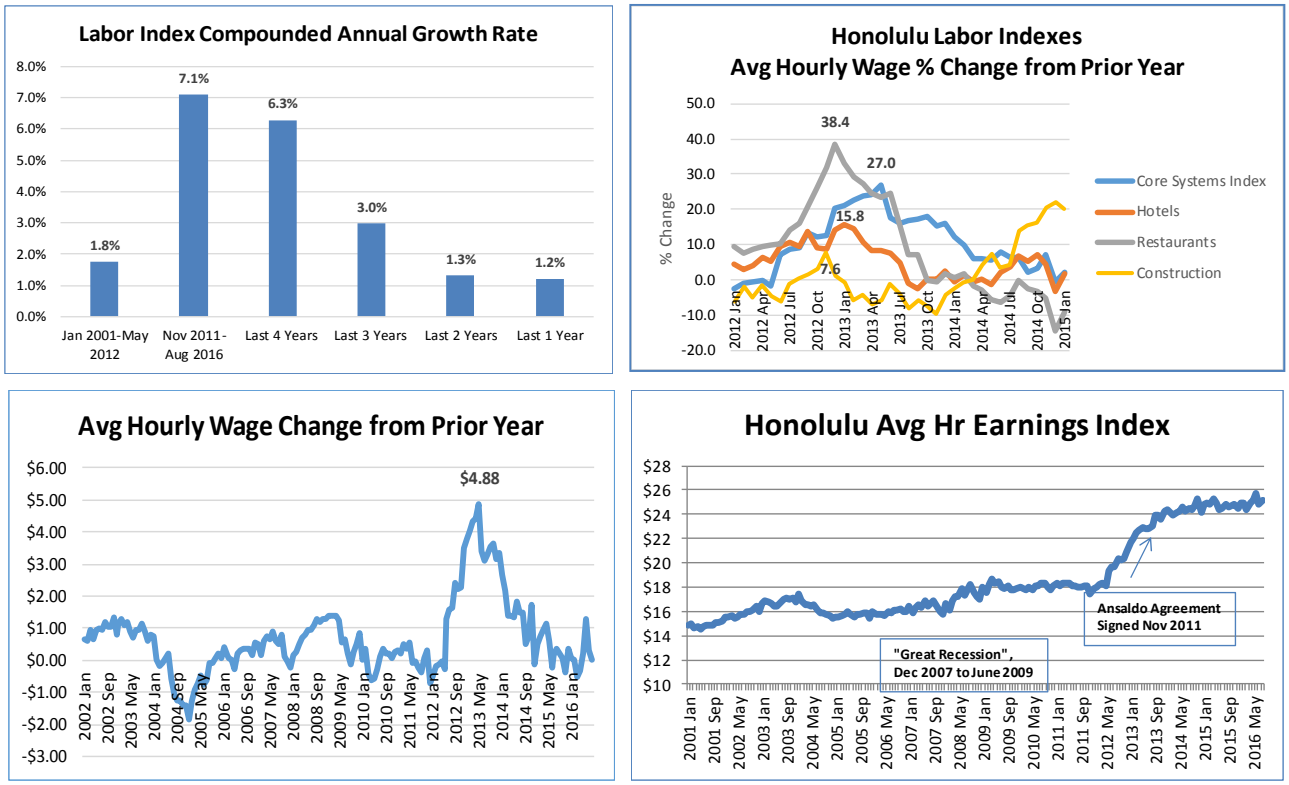
7.3.3.1.1 *Core Systems Contract*

The Core Systems Contract was signed with Ansaldo to operate and maintain the rail system. The O&M costs for the Project were developed using prices from the Core Systems Contract awarded in 2011. The Core Systems Contract has formulas to convert the bid award's 2011 dollars to YOE dollars. The formulas are based on indices published by the United States Bureau of Labor Statistics (BLS) for labor costs and material costs. The contract's labor index is based on the Honolulu Average Hourly Earnings of Production Employees in the Trade, Transportation, and Utilities Sector. The materials index is a composite of two national Producer Price indexes for Line-Haul and Rapid Transit Cars.

For the original Financial Plan, 11 years of historical data from the BLS were used to escalate the O&M costs that are included in the Core Systems Contract. The greatest deviation from the original Financial Plan is the Core Systems labor escalation factor. The Core Systems Contract was signed in November 2011. The following figure shows the labor index spiked in early calendar year 2012, reflecting the pent up pressure after the "Great Recession." Average hourly wages grew $4.88 per hour (27%) from the previous year in May 2013.

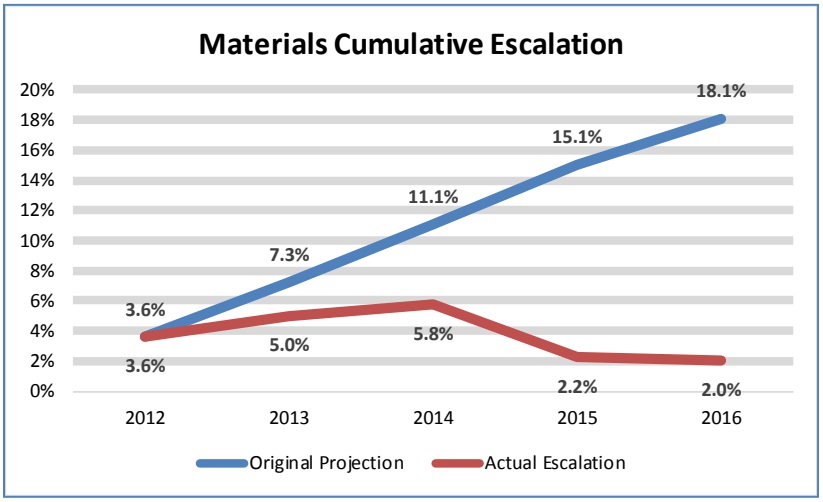
Similar spikes in the average hourly rate increase were experienced in other major sectors of the Honolulu economy such as the restaurant, hotel, and construction sectors. Contractually the labor CAGR peaked at an annualized rate of 17% in early 2013. The CAGR for this labor index from the execution of the contract in November 2011 through August 2016 has since dropped to approximately 7%. This labor index has averaged only 1.3% growth per year over the last two years. Despite the falling growth rate, if the rail systems started now, the escalation would add approximately $9 million to operating costs.

Figure 7-2: Honolulu Labor Index, August 2016



Unlike the labor index, the materials composite index is much lower than the original Operating Plan projections. The materials index was expected to grow at 3.6% annually. The following figure highlights the actual change in the materials composite index is well below the original projection through August 2016. This actual index change represents a $3.6 million savings from the original plan.

Figure 7-3: Core Systems Materials Index Update



7.3.3.1.2 *City Cost Responsibilities*

The remainder of the rail O&M services will be the responsibility of DTS, based on the passage of Charter Amendment 4 in the recent 2016 elections. These costs include the following: power costs, guideway structure inspections and maintenance, security patrols, fare revenue collection and equipment servicing, fare inspection and enforcement, station maintenance (including escalators and elevators), and costs associated with the staffing of administrative and management personnel, including overhead, for the organization.

7.3.3.1.3 *HART and City Admin*

The original Financial Plan assumed that the HART organization would include 86 full-time equivalent positions in the first full year of operations. The cost estimates in the original plan assumed a stand-alone organization with a full complement of staffing, including support position such as human resources, accounting, and information technology. There was no consolidation of services with the City or the bus operator. With the recent Charter organizational changes, the plan will be updated based on new organizational structures and resource needs developed over the next year.

7.3.3.1.4 *Power Costs*

The largest operating cost besides the Core Systems Contract is electrical power. The original Operating Plan based its power consumption and demand projection from estimates in the Core Systems Contractor's proposal. The power price projection was based

on then-current industrial rates and escalated rates gradually over the projection period. These original estimates have been reviewed and updated relative to current track alignment and four car train operations.

The following table incorporates the current power consumption and demand figures with the current industrial electrical rates to calculate the current dollar impact for power costs. The table reflects the impact of the updated power consumption total that increases power costs by $1.8 million. This power consumption increase is offset by a decrease in electrical rates of $3.1 million, resulting in a total decrease in power costs to $16.5 million in current dollars. The $1.8 million savings grows to $2.5 million when the original plan is escalated to current-year dollars.

Table 7-3: Power Consumption and Rate Variances

	Original Plan	Update 2016	Change	% Change
Power Rate Comparison:				
Usage per kwh	$0.22	$0.157	$ (0.06)	-29%
Traction Demand per kw	$18.86	$24.34	$ 5.48	29%
Station Demand per kw	$11.11	$24.34	$ 13.23	119%
Volume Comparison:				
Energy Consumption kwh	69,470,784	77,137,606	7,666,822	11%
Demand kw	10,920	11,355	435	4%
Cost Update:				
Annual Power Cost	$18,303,028	$16,545,748	($1,757,281)	-10%
Cost Variance:				
Change in Rates		($3,112,227)		
Change In Volume		$1,777,130		
Mix Variance		($422,184)		
Total Variance		($1,757,281)		

7.3.3.1.5 *Fare Collection and Enforcement*

Ticket vending machines were originally envisioned for the rail system with fare enforcement officers verifying payment. A new automated integrated fare collection system that can be used throughout the entire transportation system is currently being implemented. In addition, the Project now includes fare gates thereby eliminating on-board fare enforcement. The integrated fare collection system and other associated costs increases rail's share of collection costs to $3.3 million in current dollars, a net increase of $0.6 million.

7.3.3.1.6 *Guideway and Station Maintenance*

The Core Systems Contractor is responsible for all maintenance associated with operating the rail system, including all track and equipment on the guideway. DTS will be responsible to inspect and maintain the guideway structure, station structures, and station elevators

and escalators. The estimate includes resources to cover mandated guideway inspection, graffiti removal, and elevator/escalator repair, and includes reserves to accumulate for major station and guideway repair. The updated figures increase both guideway and station maintenance by approximately $0.5 million each for a combined total of approximately $4 million per year.

7.3.3.1.7 *Security*

The rail system will have over 1,650 security cameras, emergency and information call points, sophisticated security software, as well as security staffing. The original security plan included an eight-position staff as well as fare enforcement officers. The increase of $1.2 million in the cost of security reflects the need to increase staffing to offset the reductions in prior plan's fare enforcement officers.

7.3.3.1.8 *Cost Adjustments Related to Inflationary Growth Rates*

Once the operating costs are determined in current dollars, these cost estimates must be converted to future YOE dollars. The following table provides escalated costs under a variety of inflation assumptions. The chart demonstrates that the future first year operating costs could vary from approximately $127 million to $144 million depending on escalation assumptions.

Table 7-4: Rail Costs under Various Inflation Assumptions

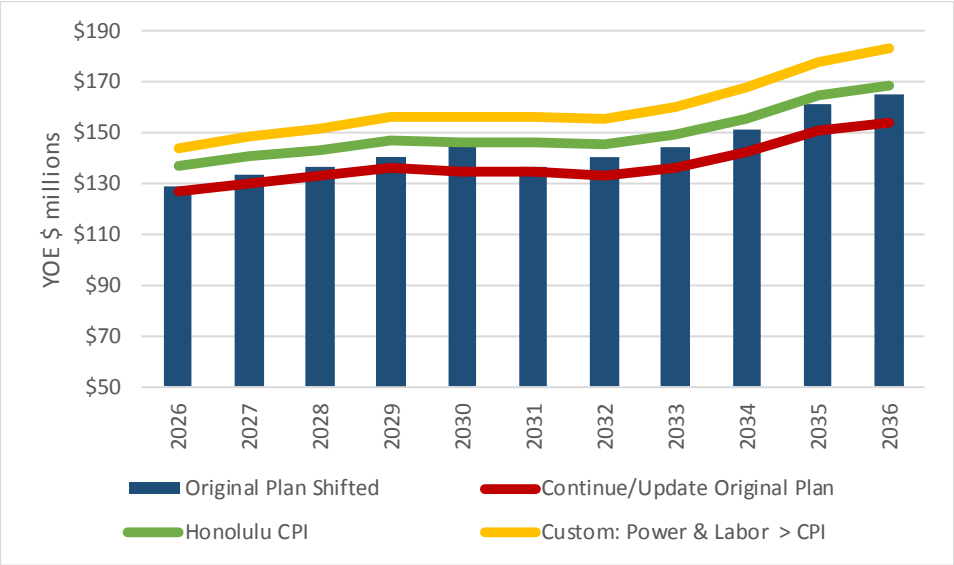
	Inflation Factor Scenarios:					
Cost Category	Continue FFGA Escalation Factor to FY 2026	Change From FFGA FY 2026	Honolulu CPI to FY 2026	Change From FFGA FY 2026	Custom Inflation	Change From FFGA FY 2026
Core Systems Labor	$ 40.5	$ 10.5	$ 46.7	$ 16.7	$ 51.5	$ 21.5
Core Sys. Materials	$ 30.0	$ (4.0)	$ 27.2	$ (6.8)	$ 27.4	$ (6.6)
Core Systems Admin	$ 14.9	$ (0.7)	$ 18.8	$ 3.2	$ 19.1	$ 3.5
Subtotal	$ 85.3	$ 5.8	$ 92.6	$ 13.1	$ 98.0	$ 18.5
HART Admin	$ 8.7	$ (6.0)	$ 8.8	$ (5.9)	$ 8.8	$ (5.9)
Power Costs	$ 19.1	$ (2.7)	$ 21.5	$ (0.4)	$ 23.6	$ 1.8
Guideway Maint.	$ 3.3	$ 0.6	$ 3.3	$ 0.6	$ 3.3	$ 0.6
Security Patrols	$ 2.6	$ 1.6	$ 2.5	$ 1.6	$ 2.5	$ 1.6
Fare Enforcement	$ -	$ (2.6)	$ -	$ (2.6)	$ -	$ (2.6)
Fare Collection	$ 4.3	$ 0.8	$ 4.2	$ 0.8	$ 4.2	$ 0.8
Station Maint.	$ 3.5	$ 0.6	$ 3.6	$ 0.6	$ 3.6	$ 0.6
Water	$ 0.0	$ 0.0	$ 0.0	$ 0.0	$ 0.0	$ 0.0
Subtotal HART	$ 41.5	$ (7.6)	$ 43.9	$ (5.2)	$ 46.1	$ (3.0)
Total Projected O&M	**$ 126.9**	**$ (1.8)**	**$ 136.6**	**$ 7.9**	**$ 144.1**	**$ 15.5**

7.3.3.1.9 *Continuing Original Plan Methodology*

This projection scenario applies the original operating plan inflation factors to current dollar cost estimates. Under this scenario, the labor index for Core Systems would continue to fall back to historical trend lines, and power costs inflation would remain low. Core Systems material inflation would reverse its current low to-date escalation and grow at its original Financial Plan annual rate of 3.6%.

In this scenario, total rail O&M cost would total approximately $127 million in the first full year of operations. This scenario would result in a cost savings of $1.8 million per year over the original Financial Plan cost projection inflated to the December 2025 starting date.

Figure 7-4: Comparison of Cost Escalation Scenarios, FY2026–FY2036, YOE Dollars (Millions)



7.3.3.1.10 *Moderate Range Scenario*

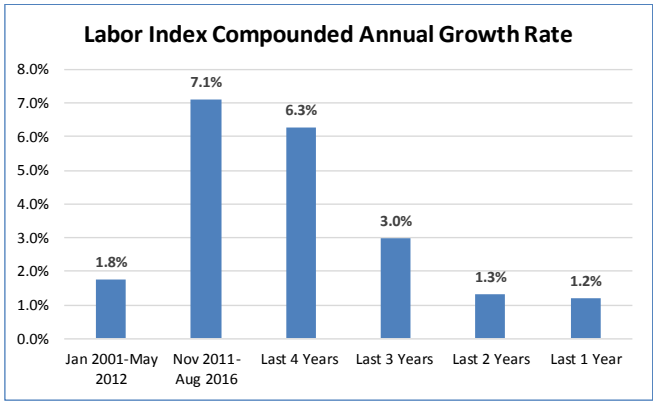
Although the Honolulu Labor Index growth rate has decreased from its post-recession spike and electric rates to date have actually decreased from 2012, this scenario increases current-dollar projections by the Honolulu CPI-U, providing another cost perspective. This scenario uses the State Department of Business, Economic Development and Tourism's (DBEDT) most recent Honolulu CPI-U forecast (November 15, 2016) through 2019, and then steps up CPI-U from 2.6% to 2.8% annually.

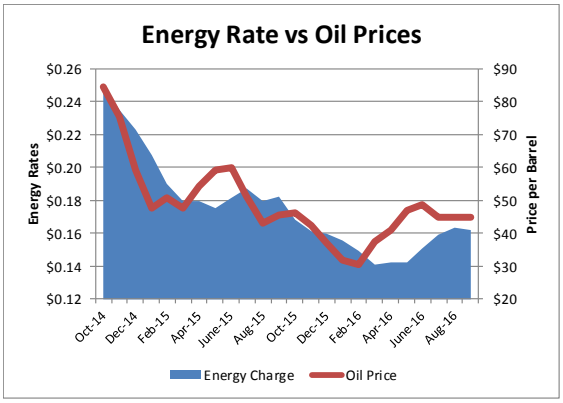
In this scenario, total rail O&M cost would total $136.6 million in the first full year of operations. This scenario would result in a cost increase of $7.9 million (6%) per year over the original Financial Plan cost projection inflated to the December 2025 starting date.

7.3.3.1.11 *High Cost Range Scenario*

The Core Systems labor and power costs represent approximately 50% of the current update for rail costs. To date, these costs have exhibited the most volatility. A more conservative forecasting approach would be to assume higher escalation factors than under the original Financial Plan methodology. Increasing these two cost categories approximately 1.4 times CPI-U results in total rail cost increasing to $144 million (11%) in the first full year of operations.

Figure 7-5: Core Systems Labor Index and Industrial Power Correlation



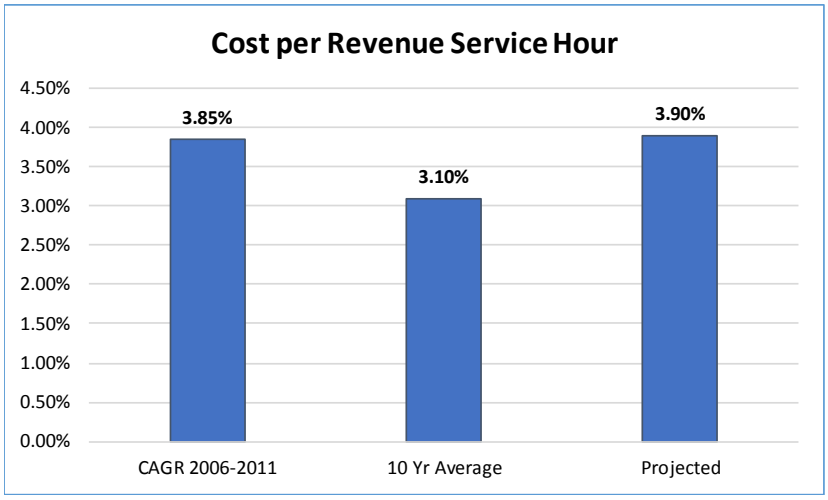


7.3.3.2 TheBus O&M Costs

In the original Financial Plan, TheBus O&M costs were developed using existing bus operations as the baseline as well as anticipated service levels through FY2030. TheBus O&M costing methodology uses a resource build-up approach that fully allocates O&M costs based on level-of-service variables. Each unit cost is broken down by object class which allows for applying different inflation rates to each object class. The overall composite cost based on revenue service hours was a 3.2% annual cost increase.

The following figure compares the inflationary growth factors cited in the original Financial Plan from 2006–2011 (3.9%), the updated 10 year average (3.1%), and the average used in the updated projection (3.9%). The updated projection uses a more conservative estimate given that the most recent years have realized savings from a sharp decrease in fuel costs. The total cost per revenue service hour for bus operations is currently approximately $130.

Figure 7-6: Growth Rates of Bus Costs per Revenue Service Hour

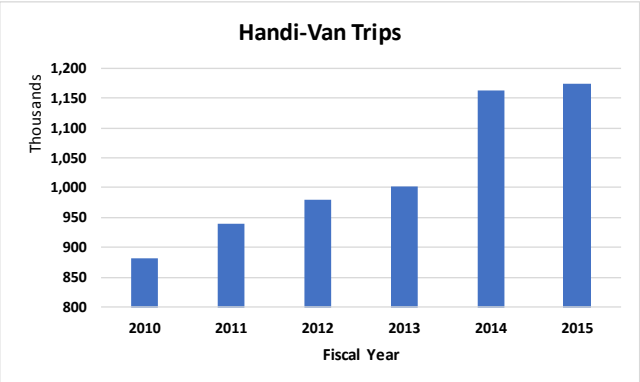


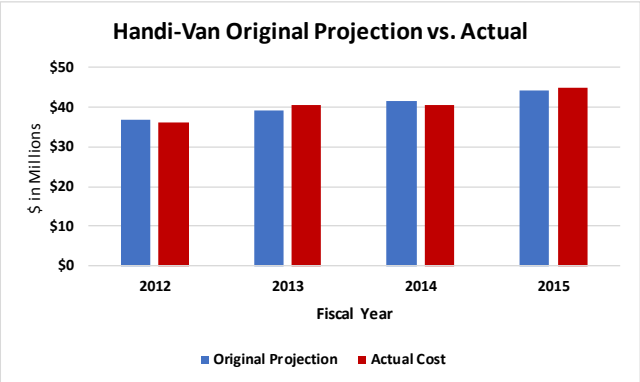
7.3.3.3 TheHandi-Van O&M Costs

TheHandi-Van is a paratransit service operating in tandem with TheBus and has been in operation since 1999. In FY2011, TheHandi-Van serviced more than 940,000 trips with an associated total O&M cost of approximately $34 million. The projected O&M costs for TheHandi-Van are based on the FY2011 cost per rider, equal to $36.32, applied to the projected ridership, and adjusted for inflation.

The original Operating Plan assumed that TheHandi-Van ridership would increase at an average annual rate of 1.8% from FY2011 to FY2030. The overall Handi-Van total cost was projected to increase between 5% to 6% per year given the increase in ridership and inflation. Fiscal Year 2015 actual results and the original Financial Plan estimate were $44.8 million and $44.1 million respectively. The updated Financial Plan continues the assumptions in the original Financial Plan for the Handi-Van.

Figure 7-7: Handi-Van Annual Trips and Operating Costs





7.3.3.4 Other O&M Costs

The Financial Plan also includes operating costs associated with other transit service programs. The projection increases over time from approximately $1 million in FY2017, up to $8 million per year in FY2036.

7.3.4 Operating Revenues

7.3.4.1 Passenger Fares

7.3.4.1.1 *Fare Policy*

A City resolution stipulates that the farebox recovery ratio (FRR) for TheBus be maintained between 27% and 33%, which demonstrates a commitment of the City to keep operating costs and revenues growing at a comparable rate on average. The Charter Amendment 4 recently approved during the November 2016 General Election created a Fare Commission tasked with the responsibility of establishing fares for TheBus, Handi-Van, and the rail, including transfer policies. However, because this Fare Commission has yet to be established and the timing for any future decisions have yet to be determined, this Financial Plan assumes that the current fare structure for TheBus will be maintained for both TheBus and the Project, with free transfers assumed between both modes.

The below table details the history of City fare increases. The City last raised fares in July 2010.

Table 7-5: TheBus Fare Structure and History

Effective Date	One-way Cash Fare		Monthly Pass	
	Adult	Youth	Adult	Youth
March 1, 1971	0.25	0.15	N/A	N/A
March 2, 1971	0.25	0.10	N/A	N/A
June 9, 1972	0.25, 0.50	0.10, 0.25	N/A	N/A
March 15, 1974	0.25	0.10	N/A	N/A
November 1, 1979	0.50	0.25	15.00	7.50
June 18, 1984	0.60	0.25	15.00	7.50
October 1, 1993	0.85	0.25	20.00	7.50
July 1, 1995	1.00	0.50	25.00	12.50
July 1, 2001	1.50	0.75	27.00	13.50
July 1, 2003	1.75	0.75	30.00	13.50
October 1, 2003	2.00	1.00	40.00	20.00
July 1, 2009	2.25	1.00	50.00	25.00
July 1, 2010	2.50	1.25	60.00	30.00

N/A = Not Applicable

7.3.4.1.2 *Ridership Forecasting*

Ridership relies on outputs from travel demand models. The original Operating Plan was based on a travel demand model used in the development of the Environmental Impact Study. The update of the Operating Plan uses the regional Travel Demand Forecasting Model (TDFM) of the Oahu Metropolitan Planning Organization (OahuMPO). This regional TDFM uses land use and population data to estimate transit system usage at different horizon years.

The TDFM estimates future island-wide vehicular traffic flows and transit ridership based on land use, employment, population characteristics, and an underlying transportation network. The OahuMPO uses the TDFM during long-range planning efforts to assess and compare the performance of different transportation projects relative to a baseline scenario.

The TDFM is a tour-based micro-simulation model system that uses the TransCAD 6.0 software package. The model uses a synthetic population and land use forecasts to simulate and track the travel patterns of each individual or household in future years. The tour-based model simulates individual daily travel patterns as a series of linked trips or tours which begin or end at home or work. Trips are simulated as one of seven different tour purposes, such as work, school, or non-mandatory trips. The tour-based framework allows consistency across trip mode choice decisions. Someone who takes a bus to work, for example, would not be able to use a car for a trip during lunch because he or she would not have a car available to make the trip. The simulation results are then aggregated and assigned to a transportation network (highway or transit service). Simulation results are also supplemented by forecasts of tourists, airport passengers, and commercial vehicle traffic.

Major inputs into the OahuMPO TDFM include long-range socioeconomic forecasts prepared by the City Department of Planning and Permitting in 2015 for the Oahu Regional Transportation Plan. Long-range population, housing, and employment forecasts for 2040 were linearly interpolated to develop intermediate forecasts for 2020 and 2030. A monte carlo simulation was used to fit a synthetic population to these targets. Overall, the land use inputs included approximately 3.4% fewer residents in 2030 than previous projections, or a total of 1.1 million people.

Other model inputs include data from the 2010 United States Census, as well as travel behavior surveys of 4,000 households and 950 visitors conducted in 2012. An onboard survey of 26,300 bus riders in 2012–2013 was also incorporated into the model. These surveys were used to calibrate the travel mode choice components of the model—that is, how the model predicts that the synthetic travelers will chose to ride transit or drive an automobile.

Another major input into the TDFM is the underlying roadway and transit projects that are assumed to be in place at the time of the forecast year. This fare modeling study includes the committed short-range highway and transit projects included in the 2040 Oahu Regional Transportation Plans that was adopted in April 2016. Proposed mid- and long-range

highway projects through 2029 and 2040, respectively, are not included in the fare model study due to their implementation horizons.

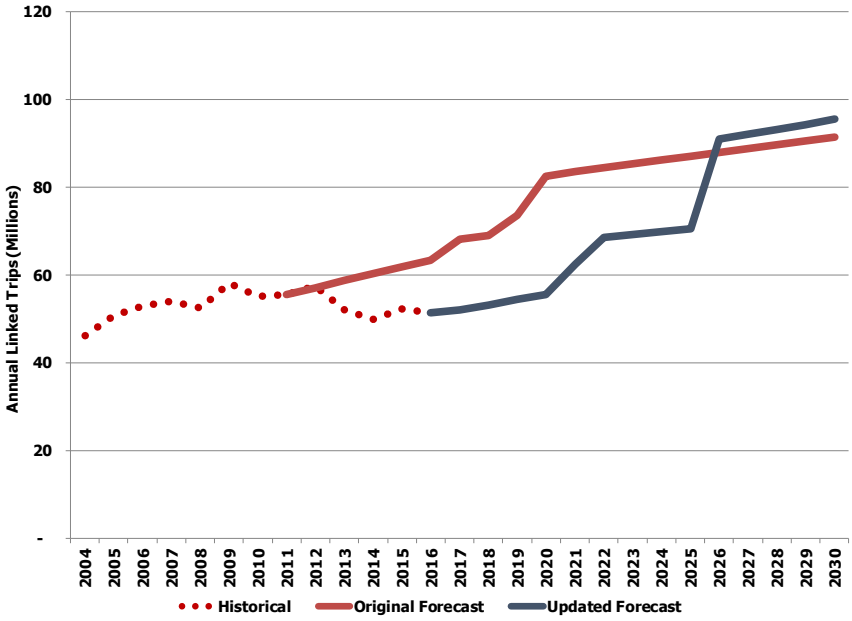
The TDFM also includes an underlying bus route network in order to simulate how travelers will use the transit system. Although DTS is developing the bus service plans that will be implemented when the rail system opens, this fare study uses two scenarios for analytical purposes.

The full-opening forecast assumes the comprehensive long-term restructuring of the bus network that was described in the Project's FEIS. This conceptual long-term bus network includes the addition of new high-frequency community circulators, truncation of regional and peak-period express routes, and a modest expansion in the bus fleet. Overall, the 2030 bus network included a roughly 20% increase in bus service hours over 2011 levels and an increase in the peak bus fleet of 474 vehicles (approximately a 10% increase).

In FY2011, TheBus reported boardings corresponded to approximately 55.5 million linked trips (taking transfers into account). The original Operating Plan estimated ridership from the original travel demand model. Approximately 258,000 daily linked trips were estimated in the first full year of a bus and rail combined system in 2020. The forecast grew to 280,000 linked trips per day in 2030 for the bus and rail combined system. Figure 7-8 displays the original Financial Plan with the updated forecasted linked trips. The updated forecast estimates approximately 279,000 linked trips in the first full year and 313,000 in the tenth year.

The figure also shows a gap has developed between 2012 and 2016. Beginning in 2013, the observed boarding and forecast began to diverge. There are a number of factors that may have contributed to this situation, but service hour reductions and the decreasing price of fuel beginning in May 2014 are likely contributors. The updated ridership forecast commences at the current ridership results from FY2016.

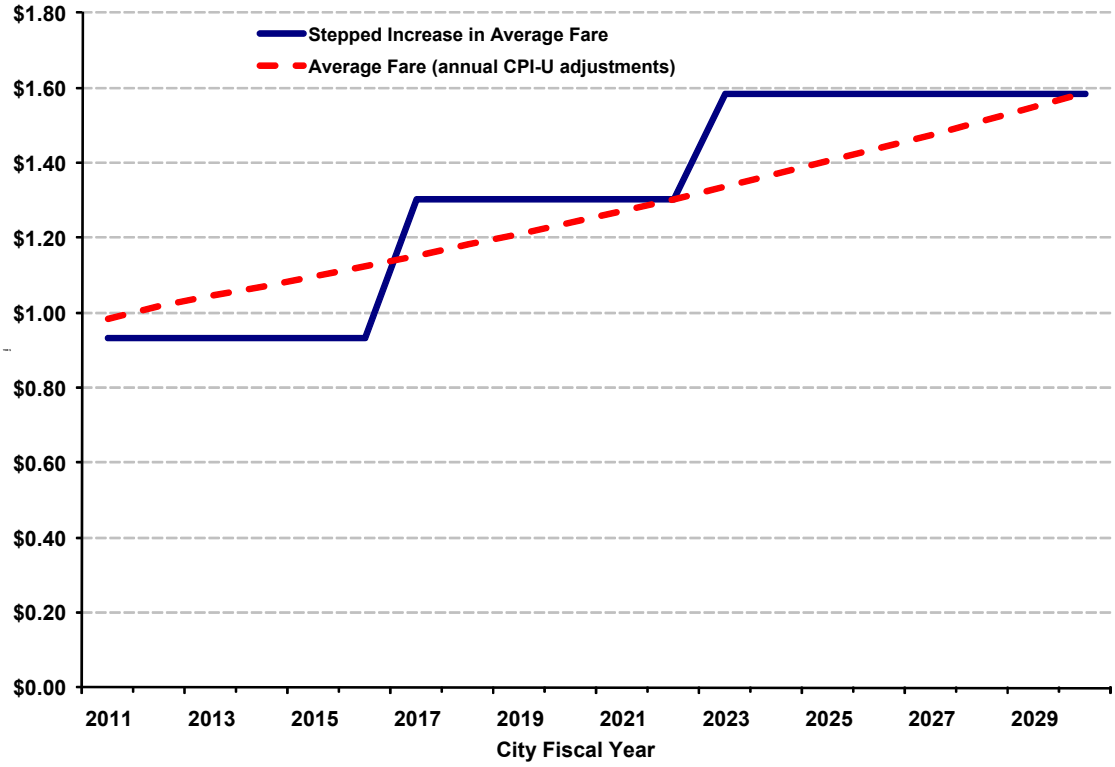
Figure 7-8: Historical and Forecasted Linked Trips for TheBus and the Project, FY2004–FY2030, Millions of Trips



7.3.4.1.3 *Fares*

The following figure illustrates the assumed future fare increases from the original Financial Plan. This figure compares the stepped up fare changes that are used as the basis for the fare revenue forecast, as compared to an annual increasing average fare. The original Financial Plan growth in average fare is assumed as a "step function" with increases of approximately $0.37 in FY2017 and $0.28 in FY2023

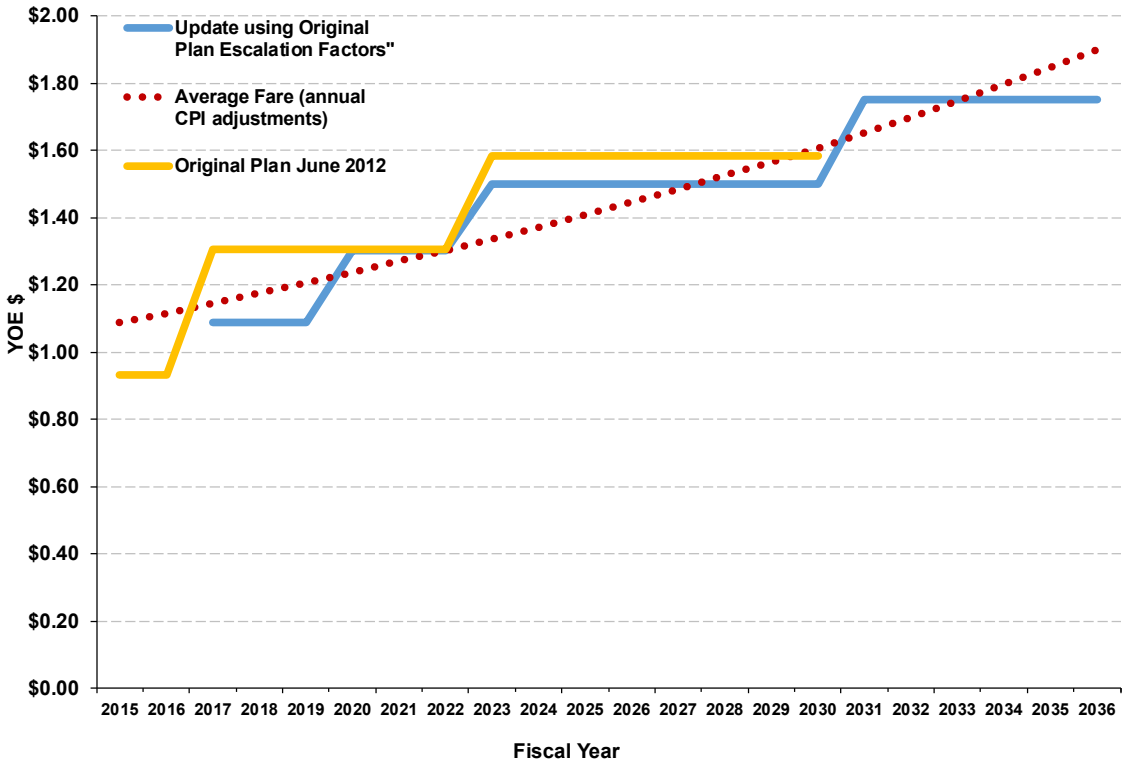
Figure 7-9: Original Financial Plan Fare Increases, FY2011–FY2030, YOE Dollars (Millions)



7.3.4.1.4 *Continuing the Original Plan Revenue and Cost Assumptions*

The following figure updates the original fare projection consistent with current City policies and fare products. The figure illustrates the impact of the shift in date of the full Revenue Service Date. This figure assumes the updated rates based on cost escalation factors in the original Financial Plan as well as revenue factors developed in the FEIS. Under this scenario, rates increase $0.20 to $1.30 in FY2020; to $1.50 in FY2023; and $1.75 in FY2031.

Figure 7-10: Average Fare Comparisons Original vs Updated Plan, YOE Dollars (Millions)



7.3.4.2 Federal Funds

The City currently receives Federal funds through FTA's Section 5307 Urbanized Area Formula Program. As mentioned in the system-wide capital plan chapter of this Financial Plan, the majority of Section 5307 funds are applied first to ongoing capital needs with any surplus being used for preventive maintenance.

Beyond the Project construction period, the Financial Plan assumes that Section 5307 funds will be distributed first to fund the Project Capital Asset Replacement Program and ongoing system-wide capital expenditures; any remaining balance will then be used to fund preventive maintenance. The updated Financial Plan also includes a projected $1 million to $2 million annually for other federal grant programs.

7.3.5 System-wide Operating Plan

7.3.5.1 Original Financial Plan Methodology

As previously discussed, this projection scenario applies the original Financial Plan escalation factors to convert current dollar cost estimates to YOE dollars and utilizes the same fare revenue factors. In this scenario, total rail O&M cost would total approximately $127 million in the first full year of operations. This scenario would result in a cost savings of $1.8 million per year over the original Financial Plan cost projection inflated to the December 2025 starting date. Average fare rates would increase with CPI-U. The original Financial Plan had average fares rising from $0.93 per trip to $1.58 in the ten-year period ending in FY2030. In the updated Financial Plan, average fares would rise $0.17 to $1.75 over the ten-year period ending FY2036.

Exhibit J-1, *Operating Plan, Continued Original Plan Methodology*, in Appendix J provides the revenue, cost, and subsidy level through FY2036.

7.3.5.2 Moderate Range Scenario

Under this scenario, rail inflationary costs grow with projected increases in CPI-U. This scenario would increase total rail O&M costs by approximately $8 million (6%) in the first full year of operations over the original Financial Plan's FY2026 projection. The original Financial Plan had average fares rising from $0.93 per trip to $1.58 in the ten-year period ending in FY2030. In this scenario, average fares would rise $0.24 to $1.82 over the ten-year period ending FY2036.

Exhibit J-2, *Operating Plan, Moderate Range Scenario*, provides the revenue, cost, and subsidy level through FY2036.

7.3.5.3 High Cost Range Scenario

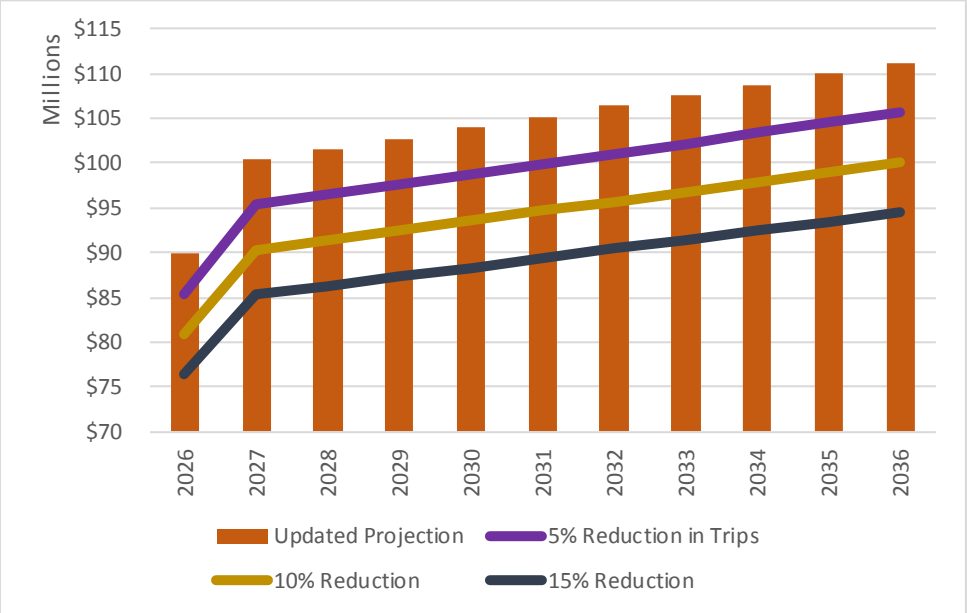
Under this scenario, rail inflationary costs grow from 3.6% to 3.8% annually for the most volatile cost categories to date: Core System labor and power costs. Growth in these cost categories would increase total rail O&M costs by approximately $15 million (11%) in the first full year of operations. The original Financial Plan had average fares rising from $0.93 per trip to $1.58 in the ten-year period ending in FY2030. In this scenario, average fares would rise $0.27 to $1.85 over the ten-year period ending FY2036.

Exhibit J-3, *Operating Plan, High Cost Range Scenario*, provides the revenue, cost, and subsidy level through FY2036.

7.3.5.4 Slower Revenue Growth Scenario

Currently, there is not an automated system to capture ridership statistics. The bus and rail system will be equipped with an integrated automated fare collection system that will provide further insight into customer travel habits. Currently, surveys are preformed periodically to determine customer travel habits. Given the reliance on survey data, potential changing customer travel habits, and other economic factors, this update models the impact of a more conservative revenue model. The figure below highlights the impact of a 5%, 10%, and 15% reduction in ridership.

Figure 7-11: Ridership Sensitivity, YOE Dollars (Millions)



The lower fare revenue in FY2026 reflects the full 20.1-mile rail system starting in December 2025, midway through the fiscal year.

HART has contracted with CH2M Hill in 2016 to undertake more detailed fare structure implementation options, including estimated ridership and fare revenue impacts. The core objective of this study is to evaluate alternative fare structure/fare policy options, including estimation of ridership and fare revenue impacts. This fare model will be used to estimate the ridership and fare revenue impacts of alternative fare structures, including changes to fare products, fare rates and transfer policies.

Exhibit J-4, *Operating Plan, Ridership Sensitivity, at Current Average Fare Rate*, provides the revenue, cost, and subsidy level through FY2036.

7.3.6 City Contribution

The City's contribution to transit O&M expenses is funded using local revenues from the General and Highway Funds. The General Fund comprises most of its revenues from the following taxes:

- Real Property Tax: Tax on real property based on assessed value; rates vary with property class.
- State Transient Accommodations Tax: 7.3% tax on a dwelling that is occupied for less than 180 consecutive days. The City has historically received a portion of these revenues.
- Public Service Company Tax: The City receives 1.9% of all public service companies' gross income.

The Highway Fund comprises most of its revenues from the following taxes:

- Fuel Tax: A 16.5 cent per gallon tax on all fuel sold or used within the City's jurisdiction.
- Vehicle Weight Tax: A tax on the net weight of all passenger and non-commercial vehicles (5 cents per pound), and motor vehicles and non-passenger-carrying vehicles (5.5 cents per pound).
- Public Utility Franchise Tax: A 2.5% tax on all electric power and gas companies' gross sales receipts.

During the period from FY1994 to FY2011, revenues from these sources totaled $14 billion, of which approximately $1.5 billion (11%) went to transit. The percentage in FY2015 totaled approximately 13%. The original Financial Plan percentage in the first full year of operations totaled approximately 19%. The updated Financial Plan, assuming no change in fare policies, fare products, and service levels, would increase to approximately 21% in the first operating year.

The Financial Plan forecasts the growth in these City Funds at an aggregate level and the resulting share that will be needed for transit operations. This forecast applies the aforementioned CPI-U inflation forecast in Honolulu as well as a real rate of growth equal to 1.3%, which is equal to the real growth experienced between FY1996 and FY2011.

Increases in other transit revenue sources, such as advertising, concession contracts, and development opportunities, could reduce the amounts required to be transferred from the City's General and Highway Funds.

Although the actual funding of the operating costs will involve further in depth review and extensive public discussion, additional offsets such as fare differentials, fare equity, cost effective routing, potential TOD related increases to tax revenues, and other revenues could provide additional resources for the Project.

7.3.7 Operating Cost Risks

7.3.7.1 Core Systems Contract

As described earlier, approximately 80% of the Project's O&M cost will be covered by the Core Systems DBOM contract, including pass-through utility costs. The O&M agreement includes pricing for labor, materials, management and administration necessary to support the O&M of the Project. As such, the risks and uncertainties around unit prices and service plan are strongly mitigated by the presence of this contract for up to ten years.

7.3.7.2 Cost Escalation – Labor, Health Care and Energy Prices

Escalation rates were applied to each Project O&M cost category from the Core Systems Contract and each object class for TheBus and TheHandi-Van O&M costs. This level of disaggregation allowed for consideration of differences in the growth outlook for various cost items, such as labor, health care or fuel prices, which may expected to increase faster than general inflation. Inflationary risks and uncertainties do remain, however, as the global and local supply/demand balance evolves. This is the case, for example, with energy costs in Honolulu, which are highly driven by oil prices and therefore are subject to its volatility.

7.3.7.3 Other Transportation Costs – TheBus and Handi-Van

The risks and uncertainties outlined above could lead to a higher level of O&M subsidy required to operate and maintain the City's public transportation system, that is, TheBus and the Handi-Van. In the base scenarios, TheBus and Handi-Van are projected to grow at higher than general inflation. The updated Financial Plan projects TheBus operating subsidy (as measured by TheBus O&M cost minus TheBus fare revenues) per Revenue Vehicle Hour (RVH) to grow at a higher rate (3.8%) than the original plan (3.2%).

TheHandi-Van service levels are driven directly by ridership growth. The annual growth rate in TheHandi-Van ridership continues to be driven by the projected growth in population above 65 years old assuming 70% of the growth. The Handi-Van's costs are projected to grow between 5% to 6% per year.

7.3.8 Operating Revenue Risks

Fare revenues are based on current demand forecasts for ridership and a continuation of current fare levels in real terms, which could both change due to a number of short-term and long-term factors such as the following:

- The state of the economy
- The local job market
- Population growth
- Traffic congestion on roads and main highways

- Fuel prices
- Land use and development plans

While the existing travel demand forecast has made some assumptions with regard to each of these variables, there are uncertainties surrounding the timing and extent of each.

The operating revenues included in the Financial Plan assume periodic fare increases that would maintain a FRR for TheBus and rail between 27% and 33%, in accordance with the City's current policy. However, the FRR would not be met if fares are not increased as shown in the Financial Plan.

The fare revenue forecast has not taken into account any temporary ridership decreases that could result from the fare increases based on previous experience demonstrating the relative inelasticity of the City's transit demand with respect to fares. Furthermore, the fare increases have been sized to increase the average fare at approximately the same rate as general price inflation, but on a less frequent basis. Accordingly, the fare increases should have a minimal effect on ridership. However, any reduction in ridership as a result of the fare increases could lead to a lower FRR.

7.3.9 Potential Mitigation Strategies for the Operating Plans

7.3.9.1 Advertising and Other Non-fare Operating Revenues

Expanding the advertising program could generate significantly more than the approximately $100,000 received by the City for bus advertisements. With the introduction of rail service, not only will there be an ability to advertise within each railcar, but the stations will also present potential advertising locations for local businesses. Based on 2011 National Transit Database data, Honolulu receives approximately $0.001 per boarding in advertising revenues, while similar larger-sized systems receive advertising revenues that are 10 to 100 times greater, after adjusting for ridership. Other miscellaneous operating revenue opportunities include the lease of right-of-way for telecommunications or the naming of stations. These funds could offset the City's contribution to O&M costs.

7.3.9.2 Parking Revenues

Demand for park-and-ride stations is strong in Honolulu, and charging even a nominal amount for daily parking could generate a significant amount of revenue. Collected parking funds could be used for capital and/or operating expenses, as parking surcharges could be used to offset the construction costs of the parking garages, or revenues could be used to offset operating costs of the garages including garage attendants and security personnel.

7.3.9.3 Improvement in Service Efficiencies in TheBus, TheHandi-Van, and Rail Operations

The addition of the Project to the existing transit network will likely result in some overlap of service between bus and rail. While some bus service and route modifications are planned as the Project is implemented, there is a possibility to further reduce redundancies in the bus service as rail ridership grows. This would have an impact on ongoing bus fleet replacement cycles, which can lead to reductions in both capital and O&M costs.

Productivity on TheHandi-Van system, as measured by the number of unlinked trips per RVH, decreased every year between FY2006 and FY2010 at a CAGR of -1.9%. However, the paratransit system experienced its first productivity gain in six years in FY2011, with riders per RVH increasing by 3.3%. The Base Case Financial Plan does not include any productivity gains beyond the one already captured in the FY2011 estimates. However, should the trend in productivity gains continue, growth in TheHandi-Van O&M cost could be further contained to mitigate a greater increase in ridership.

Appendix A: Project Maps

Exhibit A-1: HRTP Full Alignment

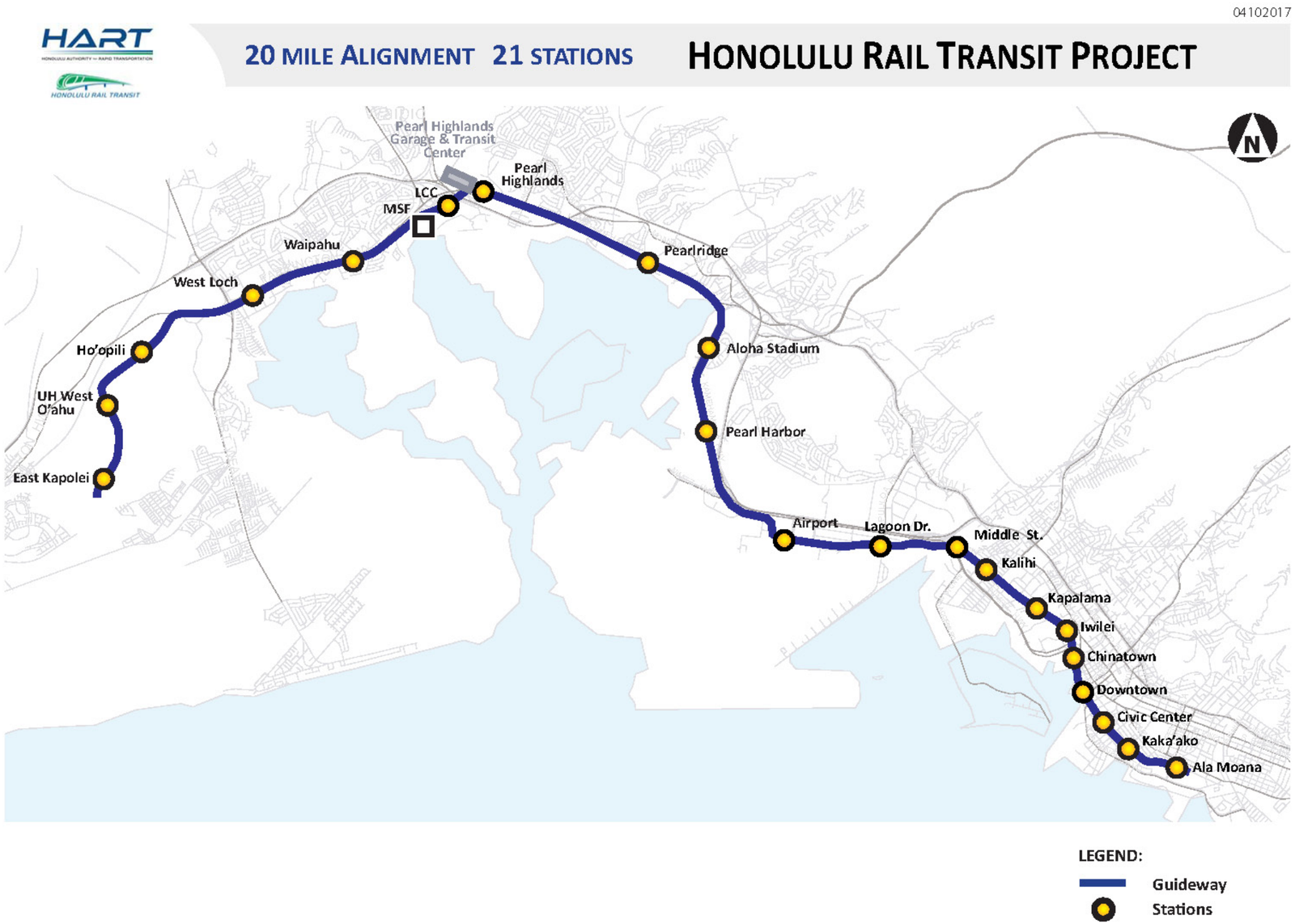


Exhibit A-2: Project Progress and Status

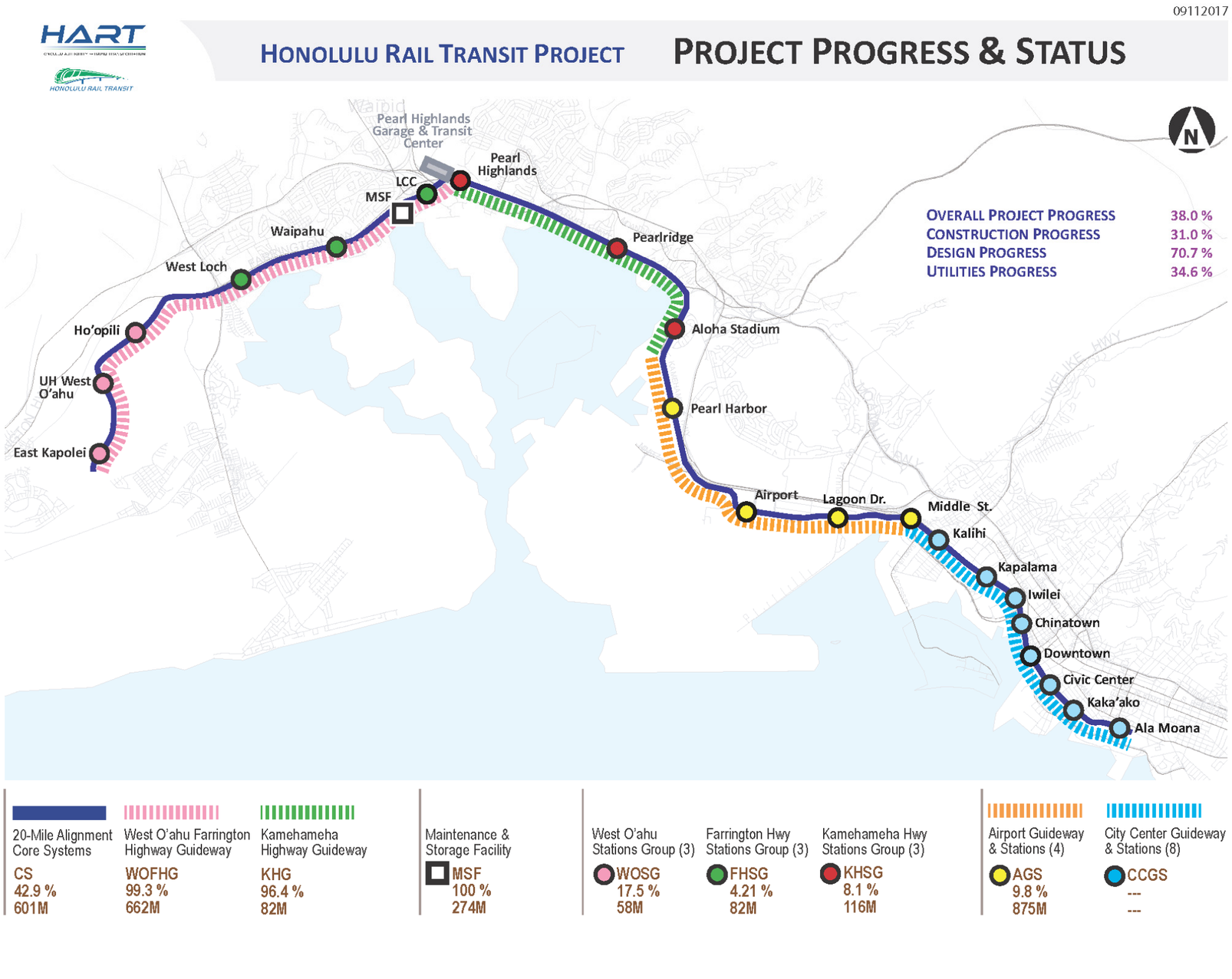
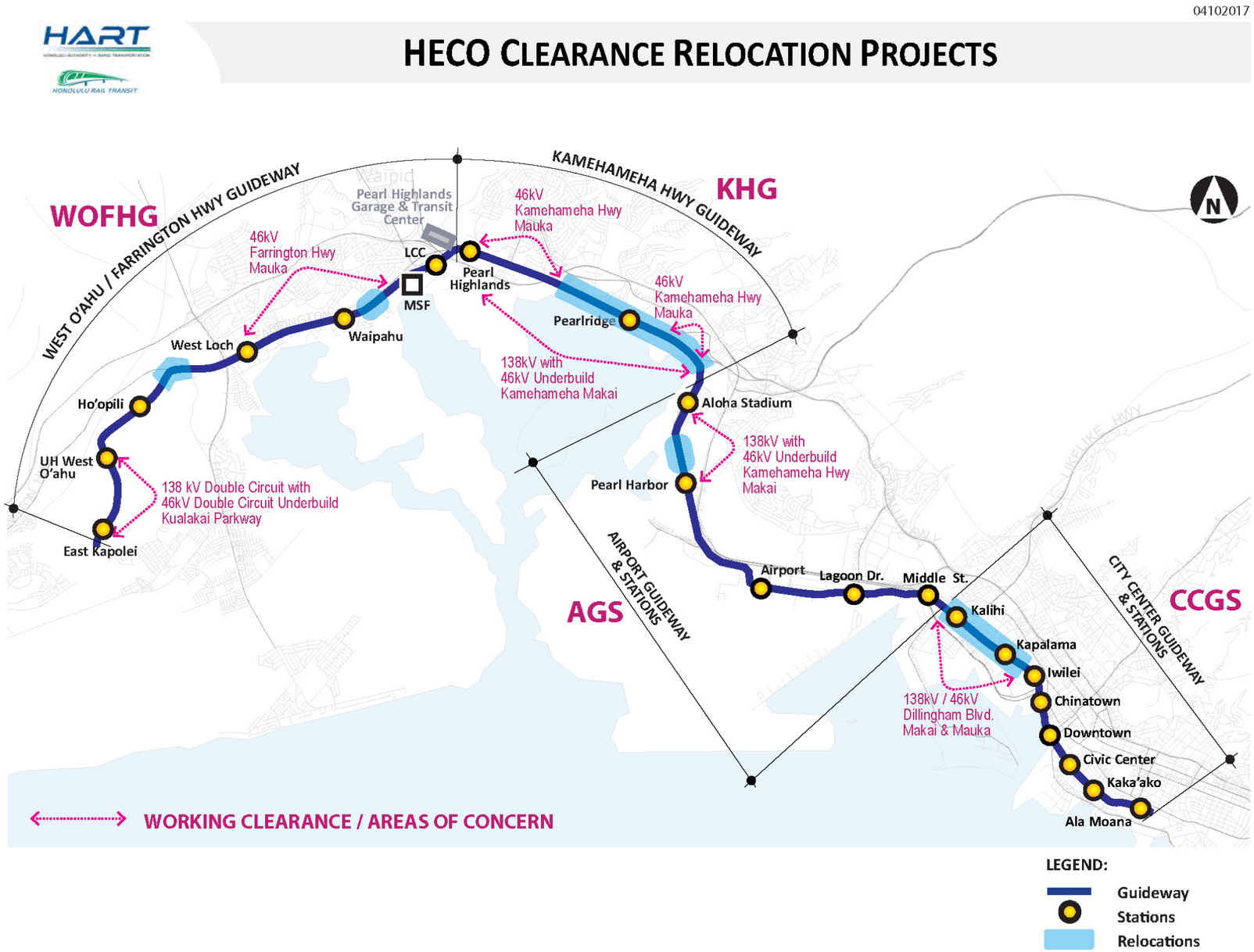


Exhibit A-3: HECO Working Clearances and Relocations



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Appendix B: Primary and Secondary Mitigation Measures

B-1 Value Engineering Proposals, Implemented

Status Date: August 31, 2017

HART implemented a formal Value Engineering (VE) Study in 2011 on the overall rail transit corridor. The VE study was facilitated by Value Management Strategies (VMS). The significant implemented cost saving ideas from this VE study are listed below.

a) Load test more shafts and increase resistance factor. Savings: $25 million.
b) Use tip grouting for drilled shafts. Savings: $5 million.
c) Perform sequential testing with O-cells for friction. Savings: $18 million.
d) Minimize the use of permanent casing for drilled shafts. Savings: $47 million.
e) Optimize lateral resistance of drilled shafts. Savings: $10 million.
f) Shift guideway alignment makai at Middle Street Station. Savings: $1.3 million.
g) Relax coincident vertical and horizontal geometric design criterion and lower profile. Savings: $1.1 million.

Additional Value Engineering efforts by HART include the following:

h) 2016: Primary and secondary mitigation lists submitted to FTA (26 Primary mitigations, and 52 Secondary mitigations, and 6 Funding ideas) have been considered. Eleven of these ideas have been implemented or partially implemented representing approximately $25 million in savings to the project. See Exhibit B-2 below.
i) 2016: Alternative Technical Concepts (ATCs) on AGS. (These ATCs are proprietary to the bidders but have resulted in approximately $25 million in savings to the project.)
j) 2012: Station modular design. This has saved approximately 10% of the station costs for modularity, equating to $20 million in savings.
k) 2011: ATCs on KHG. (These ATCs are proprietary to the bidders but have resulted in approximately $20 million in savings to the project.)
l) Pre-2011 station VE study for efficiencies in station layout and concept design.
m) 2010: ATCs on WOFH (These ATCs are proprietary to the bidders but have resulted in approximately $20 million in savings to the project.)
n) Structures optimization study, one for superstructure, one for substructure (PB for HART in the 2007-2008 timeframe). Resulted in the implementation of drilled shafts and segmental box. This value planning effort was to implement the guideway work the most economically.
o) The modular station design. The Guideway VMS study. Ala Moana station shift. ATCs on WOFH, KHG, AGS. Ranged $20 million to $30 million in savings per project.
p) 2016: Split out advanced Dillingham Temporary Utilities (DTU) packages to reduce CCGS schedule, overhead, and risk pricing. Implemented savings: $40 million.

q) 2016: Allowed AGS contractor to use drilled shaft load test data from WOFH and KHG. Implemented savings: $20 million.
r) 2016: Relaxed mass concrete specification to reduce cooling requirements. Implemented savings: $10 million.
s) 2015: Split 9-pack of West Side Station Group (WSSG) stations into three 3-packages including WOSG, FSHG, KHSG. Implemented savings: $46 million
t) 2013: Eliminated method shafts on Kamehameha Highway Guideway (KHG) Implemented savings: $2 million
u) 2012: Eliminated guideway lighting. Implemented savings for full guideway: $12 million.
v) Value Engineering Change Proposal (VECP) for piles at Waipahu Station. Implemented savings: $3 million.
w) Eliminating bioretention where possible. Implemented savings is under review.
x) Deferring certain elevators for future installation. Implemented savings: $20 million.
y) Change of the canopy design. Implemented savings: $10 million.
z) Minimize the need for station personnel. Future cost-savings in personnel (not calculated)
aa) HART's directive drawings require all final designers to specify stainless steel balustrades. The change to galvanized steel was included in the 12/19/2014 FHSG bid documents. Implemented Savings: $1.4 million.
bb) Kapalama station originally had Fare Gate Entry Modules (FGEM) on both sides of Dillingham Blvd. The Makai side FGEM has already been deleted, but could be provided under a future Transit Oriented Development (TOD) agreement. Implemented Savings: $1 million.

B-2 Value Engineering Ideas under Consideration by HART

a) Moving the terminus of Ala Moana by 200 feet. This alignment change will help with future project extensions to UH Manoa and saves money: $6 million.
b) Early utilities package for CCGS: Savings: $40 million.
c) Reducing cost of ROW acquisition by using property slices versus full takes. We've only had full takes of 15 properties. There have been hundreds of partial takes which have maintained the businesses in place.
d) Utilizing several properties by leasing to others until such time as HART must take it for construction purposes. DL Horton, UH, DLR.
e) Bringing value to adjacent property for reduced cost of land.
f) RFI to industry, which demonstrated that P3 is not workable, but it was explored.
g) Concessions and advertising at stations. Looking at power, utility connections, and space requirements to accommodate in the future.
h) The Pearl Highlands Station Parking Garage provides 40% of the total number of spaces required by the project as indicated in the FEIS. Defer until a funding sources has been identified. Provide temporary parking at other location, such as adjacent to the UHWO Station, the Ho'opili Station, or elsewhere. Cost saving potential: $215 million.

i) At the Downtown Station, the Makai fare gate entry module (FGEM) could be deleted, but vertical circulation would still be required on Makai side to access the Makai platform. Bathroom on Makai side would be eliminated. Bathroom on the Mauka side would be expanded. Cost Saving Potential: $1.5 million.

B-3 Lessons Learned

Status Date: August 31, 2017

Program Lessons Learned are being compiled by the Director of Risk Management and will be checked on all new projects moving forward with appropriate persons or teams in an effort to avoid the problem from recurring. The latest update to these items was on August 28, 2017, with input from project team members.

Exhibit B-1: Lessons Learned Master List

No.	Title	Description
1	Award contracts for the Project only after all Federal documents, such as the EIS, the ROD and the FFGA have been executed.	The City and County of Honolulu is the recipient of the Federal grant and managed the initial aspects of the Project. The City awarded contracts to the contractors as follows: November 11, 2009 — Award to Kiewit for WOFH for $482,924,000 June 14, 2010 — Original Environmental Impact Statement January 18, 2011 — Original Record of Decision June 30, 2011 — Award to Kiewit, KHG for $372,150,000 June 30, 2011 — Award to KKJV, MSF $195,258,000 July 1, 2011 — Creation of the Honolulu Authority for Rapid Transportation (HART) November 28, 2011 — Award to Ansaldo, Core Systems for $1,397,387,093 December 19, 2012 — Full Funding Grant Agreement May 28, 2013 — Supplemental Draft Environmental Impact Statement September 30, 2013 — Supplemental Final Environmental Impact Statement September 30, 2013 — Amended Record of Decision The timing of the award of these contracts contributed to the filing of lawsuits which caused significant delays and costs.

No.	Title	Description
2	Avoid committing funds in the financial plan that would impact the local community and existing transit operations.	The FFGA Financial Plan included a total of $210 million of 5307 Formula Funds to fund the Rail Transit Project over a six year period. 5307 Formula Funds can be used for a variety of purposes such as: planning, engineering, design; capital investment in bus and bus related activities, such as bus replacement and overhaul; capital investments in new and existing fixed guideway systems; and preventive maintenance. Although, this figure represented only 4% of the total project funding, it has alienated the transit rider community. The bus and Handi-Van riders were wary that the use of 5307 Formula Funds for the rail project over a six year period would result in severe program reductions in the existing services. Instead of a win-win situation, the use of existing funds for the new rail project was viewed as a win-lose situation that reduced community support for the project.
3	Avoid awarding contracts until Third Party Agreements with State, City and other entities, such as universities, have been executed.	A clear understanding, documented for the record, of each parties' expectations and commitments, is essential to progressing the work forward with minimal impacts.
4	Avoid awarding contracts until agreements have been executed with the local utilities	A clear understanding, documented for the record, of each parties' expectations and commitments, is essential to progressing the work forward with minimal impacts.
5	Avoid awarding contracts until the majority of Real Estate and Right-of-Way have been acquired.	Securing all of the required properties, including temporary construction easements, along the corridor is essential to smoothly progressing the work. While the HRTP has kept out in front of most ROW needs, there have been instances where the lack of property has either caused higher bid pricing due to uncertainty, or directly affected the ongoing work from a schedule and cost impact standpoint.

No.	Title	Description
6	Align contract packaging in such a way as to ensure contractor coordination and to minimize potential impact to other contracts by the lack of performance by a single contractor.	The fact that the interface processes and procedures were not fully established prior to the first contracts being let in 2009/2010, created disparities in the requirements with later contracts and has made implementation more difficult. Provisions for the identification and resolution of interface issues during construction for the Design-Bid-Build contracts should have been established earlier during the overall project. Finally, requiring the contractors to create a tabulation of interface points at the beginning of their contracts, in concert with their interfacing partners, is conducive to smoother implementation of interface processes. This is as opposed to initiating interface communications on an ad hoc basis as issues arise.
7	Develop contracts of a size and nature to ensure participation and competition by the local contracting community	Along with the robust market conditions, a more thorough initial assessment of the contracting capabilities and capacities in Hawaii's remote setting may have altered the initial contract packaging plan to accommodate local contractors and subcontractors. Other concurrent private work (commercial and high-rise residential) has stressed the capacities of most Hawaii-based construction companies, driving higher costs on less familiar work (HRTP) for an unknown owner (HART). Given the choice of current opportunities, most local firms favored their bread-and-butter, repetitive floor plate work rather than venturing into new territory – or – they priced their work accordingly (higher) on the HRTP.
8	Recognize Current and Future Market Conditions	Unfortunately, the delays in the initiation of the Project and interruptions caused by lawsuits occurred at a time of extraordinarily significant increase in market cost, causing labor, material, and equipment costs to soar during the subsequent several years. While some accommodation for escalation was provided in the 2012 Full Funding Grant Agreement (FFGA) at approximately 3% per year, one could not have forecast that escalation in Hawaii would experience quadruple that expectation in 2014 and 2015, projecting the same for 2016 (12% annually), then somewhat tapering back. There is a fine balance in assessing this escalation rate projection during the execution of an FFGA, trying to keep initial cost projections down while including some conservatism in case significant cost increases occur. Given the history of this program, along with other recent major capital programs in the US, it does appear that the best lesson is to be more conservative in initial FFGA cost estimates and escalation projections.

No.	Title	Description
9	Focus on detailed contract scope refinement	Coupled with the assessment of the local contracting capabilities, keeping the right scope in the right package could have been improved upon, given what is known now from contractor feedback and the complexity of interfacing several separate contracts. For example, the long-span platform box girders included with the station entry building contracts should have been more appropriately been included in the large bridge structure guideway contracts. Similarly, the low voltage electrical scope (public address, fire alarm, security, etc.) being performed by the Core Systems Contractor, and the furnishing and installation of the elevators and escalators let as a separate contract, would be more effectively performed by subcontractors working for the station general contractors. Some of these lessons have been implemented in the development of the east guideway contracts as Design-Build contracts containing both the guideway and stations. The low voltage and elevator/escalator complexity remains however, to be handled as an ongoing interface resolution issue.
10	Become more aware of contractual risk management	Placing all, or nearly all, of the risk on a contractor or consultant will inevitably drive initial project costs higher. Conversely, preparing contract terms and conditions where the owner takes the majority of risk can result in significant claims and subsequent cost overruns as well. HART's contracts, general conditions, special provisions, and other terms of agreement have continued to evolve over the past several years to try and strike a balance between overly onerous or too lenient terms. After the over-budget west side station package results, contractor feedback solicited in late 2014 resulted in a major re-write of the general conditions and special provisions and the initial results from the new west side station procurements have been favorable.
11	Begin Traffic Planning and Management before contracts are awarded	The trade-off between mobility of commuters and accessibility to property is extreme due to localized travel behavior and past practices of contractor responsibilities for MOT. Historically, HDOT and other agencies impacting traffic have provided broad guidelines to the contractor and that has been adequate. The same principles have been applied to HART's project. However, in other locations where projects of this duration and complexity have had such a major impact, there has been much more extensive traffic planning and impact analysis. HART acknowledges their need to partner more closely with the City and with property owners to work through these issues in concert with the contractors. This is getting much more scrutiny than previously as the project migrates from West to East applying real time what is learned on almost a daily basis. Another aspect of this is the need to be more pre-active in the business impact mitigation at an earlier stage of the project. There is a need to anticipate the impact, provide outreach to the businesses before the impact and together develop mitigations to assist them.

No.	Title	Description
12	Ensure that Technical Capacity and Capability is acquired early and is redundant	Globally, the quantity of qualified transit professionals is in short supply as the demand for transportation choices and more sustainable solutions is increasing faster than Universities and direct experience can maintain. The HRTP is a major undertaking that will take many years to complete. Staffing up with the correct technical skills at market prices within the City's salary structure is a challenge. Mobilizing the requisite transit expertise from outside the state of Hawaii and combining with local professional skills with enough people to cover the volume of work to be performed is the key. The problems of relocating to Hawaii are not new. The cost of living and sacrifices to personal family situations are a barrier of entry let alone acceptance and integration into the community which is based on long standing extended family social structures. Attrition rates are higher than most comparable projects and the impact of these factors on schedule, budget and quality is difficult to quantify. Succession planning and incorporating more local staff while transferring technologies, tools and best practices is essential for HART's long term success.
13	Temporary Construction Easement (TCE).	As a HART management decision, it was decided to transfer the responsibility of obtaining and managing all TCE's to the DB's. Consider a list of HART owned properties in RFP. Have contractor price the risk in their bid. This will leave HART with more important R/W acquisition tasks for full or partial takes, but not with means and methods that the contractor needs to determine resulting in TCE's. Resolved for City Center if it is DB, but if it is DBB then HART may coordinate some TCE's because our design is not constructible within the existing R/W without the benefit of TCE's.
14	Not all parcels acquired prior to NTP for earlier CCGS. Anticipated availability dates included in RFP. Led to delay claims in other projects.	Identify and prioritize parcels and put into a schedule to define anticipated times. Once dates map out, include in RFP +X days (current strategy). Evaluate risk with FTA approval. August 2017 update: Lesson learned is going to a unit rate type contract for utility work.
15	Unidentified easements or ROW parcels.	If the change is triggered by change of design then responsibility of DB per RFP, provided it's constructible. Constructability review of utility and roadway design. August 2017: Risk response strategy is to perform a constructability review of the utilities and roadway design to make sure sufficient property is available for construction use.

No.	Title	Description
16	Quality of stamped plans (utility and roadway).	SUE data provided to AECOM for their design. Constructability reviews including independent third parties such as HECO, HDOT, HTI, AT&T, HawaiiGas. August 2017update: SUE data is being completed and will be provided to AECOM from August 2017 through November 2017. This information will strengthen the utility system design for CCGS.
17	SP-7.3.2 on misidentified/unidentified utilities. 365 days for investigating unknown utilities.	Cap or share the risk via deductibles. Include list of properties that have not been investigated. August 2017 update: HART takes responsibility for any misidentified/unidentified utilities in year 1 of the contract. After that the risk is transferred to the DB. If it changes to DBB then HART owns this risk.
18	HECO Work	Analysis of whether third party or DB contractor. August 2017 update: We have a choice of one or two contractors for conduits and cables. This is a mitigation to help move the process along and satisfy technical requirements. HECO's preference is that HART coordinate the work for MOT, public outreach, trenching, conduit placement, pulling conductors, terminations, testing, etc.
19	Utility Agreements	Owners obtaining all agreements (current plan). Include agreements in RFP. August 2017 update: Lesson learned is to obtain the utility reimbursement agreements as soon as possible prior to bringing the contractor on board.
20	Service Connections	DB contractor complete design infrastructure with HECO. Clearly define work between On-Call and DB, try not to have activities sandwiched. Consider scoping DB for service connections and demolition. August 2017 update: This is a pending risk. Contractor will build a ductbank or series of poles. On-call will pull the cables (On Call 4 is standing HECO). The DBB (or DB) utility contractor will create service reconnections to existing buildings. For City Center we can have all work for utility relocations performed by a unit price contractor rather than splitting the work out to several contractors or to a DB.
21	Defined early access to pull guideway cable.	Liquidated Damages for CAM dates. August 2017 update: Construction Access Milestone (CAM). Most contracts to date have had CAM dates for interface between contractors. We have the dates but not financial penalties associated with not meeting the dates. Lesson learned is to have financial penalties associated with CAM's.

No.	Title	Description
22	Train Control and Communication Room (TCCR) – connection to guideway. Room readiness.	a) Evaluate A+B in quality equation: This is associated with CAM dates, concerning allowing the contractor flexibility in sequencing their work, with contractors defining CAM dates, then scored by HART, such as staggering the completion of stations to allow Core Systems to sequence their work from station to station. b) Provide table of CAM dates. See item a. Blank would go to contractor to fill in, in the procurement documents. c) Equipment infrastructure installed. Core systems must do this. This has been the plan. d) Define temporary power requirements for any turnover to CSC. e) Incentives (quality, safety, early access, etc.). Incentives have not been used in earlier contracts. Under discussion for CCGS.
23	System site access – connectivity to guideway. Passenger screen gates installed.	Evaluate A+B in quality equation; Provide table of CAM dates. Equipment infrastructure installed. Define temporary power requirements for any turnover to CSC. Incentives (quality, safety, early access, etc.) See item 22 above.
24	Dillingham full road closures.	August 2017 update: The schedule options for CCGS assume major lane closures along Dillingham. The more lanes that can close at a given time, the faster the construction can occur.
25	Mitigating delay.	A+B with LD and/or incentive. August 2017 update: Working on incentivizing the contractor for performance versus allowing the contractor to exploit the risk.
26	Extended overhead cost included in contract.	Remove language from RFP. August 2017 update: In WOSG, FHSG, KHSG, and AGS: HART had bidders propose a competitive unit rate for each day of delay. The lesson learned is don't do this. Preferred to negotiated delay costs versus having them defined in the contract or on the bid form. ASU is an example of a defined unit rate for delay that the contractor may be using beyond the original intent. If this approach is used we must be careful to clarify the context of its application.
27	Interim milestone Dillingham corridor utilities/roadway.	Consider no excuses incentive. August 2017 update: No excuses incentive was intended to prevent or deter the DB from exploiting inconsistencies on stamped plans. We wanted to incentivize the DB for completing the work regardless of the unforeseen conditions. It is being used successfully on other transit projects including Florida DOT and Caltrans. It has been refined.
28	Progress payments on true earned value.	August 2017 update: Discussions have resulted in reporting work progress on actual construction completion versus including front-end soft costs such as mobilization which tends to overstate the actual construction percent complete. However, changing the way that progress payments are made continues to be a topic for study as a lesson learned.

No.	Title	Description
29	Modification of RFP documents to account for DBB portion.	Considerable revisions to current RFP Include bid item for minor changes Utilize FA process. August 2017 update: need to define the DBB work conducted for the DB's information.
30	Delivery Schedule.	Project team and project controls evaluation of delivery schedule Define a granular schedule for risk modeling Reallocate risk to granular schedule. August 2017 update: Associating risks with activities in the schedule so we understand what is concurrent and what is sequential.
31	Incorporate lessons learned from CE&I staff of West Side.	Site tour of Pearl Ridge, Peal Highlands, and Aloha Stadium station construction projects with C&I team on 24AUG2017 included discussions about lessons learned. Risk Manager to set up a Lessons Learned session with those staff to obtain their input and share with East Side team.

Exhibit B-2: Cost Constraints

Primary / Secondary	Category	Scope Change Concept	Description	System wide Potential Savings	Design / Schedule Impacts	Other Considerations
Primary	Scope - Other	Construction Camera Surveillance	Optimization or deletion of mounted cameras for "in process" construction photography	<$1M	Minor	
Primary	Scope - Other	Eliminate landscaping	Revise or eliminate median landscaping and use ground cover or grass	<$1M	Minor	Implemented on AGS. In progress on CCGS.
Primary	Third Party	Maintain overhead utilities wherever possible	Majority of savings would be realized on the west, on Kamehameha Hwy.	$30M - $200M	Very Significant	Discussions with HECO have proven very successful and agreement is being reached
Secondary	Scope	Pearl Highlands Garage & Transit Center	Review foundation designs	$25 M - $90 M	Significant	
Secondary	Scope	Core Systems - Electrical Power Backup	Eliminate Generators (4)	$12 M		Study underway with HECO to add energy saving devices
Secondary	Scope - Stations	Consider center platform and straddle bent design at Chinatown through Kaka'ako	Looking at Ala Moana there appears to be significant simplicity and savings in the station design with a center platform. And expanding that concept may allow enough guideway efficiency.	$5M - $10M	Very Significant	Straddle bents at Chinatown previously determined to be infeasible, hence current cantilevered design.
Secondary	Scope - Stations	Reduce aesthetic treatments	Cut all aesthetic treatments beyond what was considered in the VE effort. No pavers, stained or stamped concrete, wall tile and blocks, etc.	$5M - $10M	Significant	
Secondary	Scope - Stations	Reduce plaza areas	Provide only absolutely necessary sidewalks. Xeriscape or gravel remaining areas.	$5M - $10M	Significant	
Funding	Scope - Track	Eliminate three cross-overs	Review track and scheduling to determine where savings can be realized	$2 M	Minor	Could potentially increase operating costs.
Secondary	Scope - Stations	Simplify either Iwilei or Chinatown Station construction (due to proximity)		$1M		Indeterminate, but possible in range of $500K to $2M
Funding	Co-development	Funding - Look at alternative funding sources for "complete streets" and non-motorized mobility				
Secondary	Scope - Other	Procure more extensive mapping of existing utilities	More extensive mapping of existing utilities will save cost by minimizing changed conditions during construction	$100 M	Significant	Utility mapping for City Center started in late 2016. Data will be incorporated into RFP documents by HART, and may be incorporated into utilities design by AECOM.
Primary	Scope - Guideway	Shift Guideway on Dillingham to Makai Side	Shift the alignment of the guideway from the center of Dillingham Blvd to the makai side to avoid minimize utility relocations and traffic impacts.	$50M	Very Significant	Requires additional ROW, which would likely trigger a Supplemental EIS and associated program schedule delays. Therefore, this option is only worth considering if the program is significantly delayed for other reasons.

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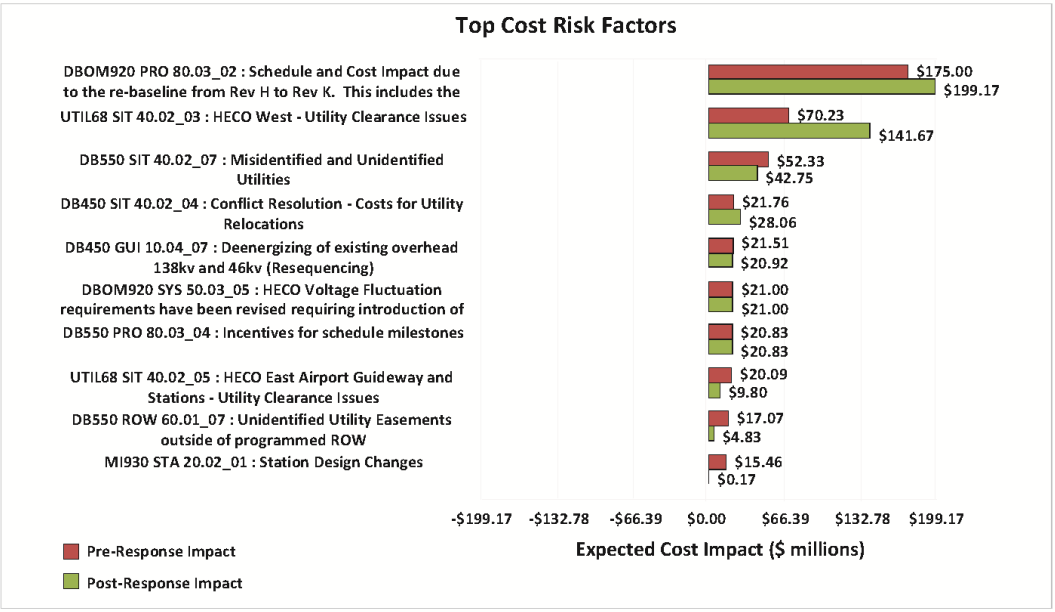
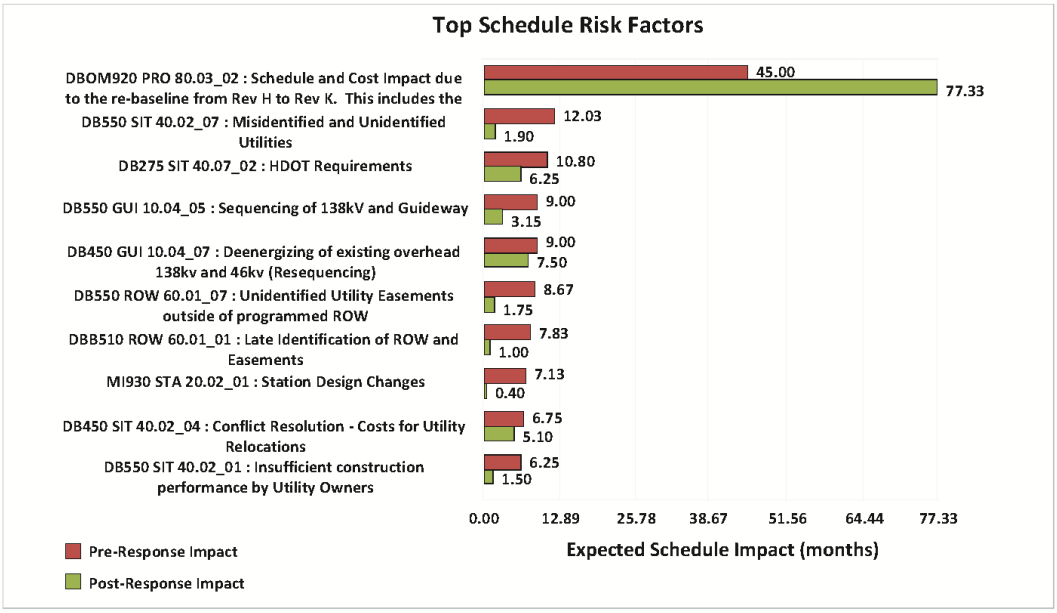
Appendix C: Program Risks

Exhibit C-1: Excerpt from Risk Tractability Log

Total Count	
Active Risks	215
Inactive Risks	15
Pending CO Risks	1
Retired Risks	132

	Pre-Response Cost	Pre-Response Schedule	Post-Response Cost	Post-Response Schedule
Total Expected Value Threats	$744.1	266.7	$812.2	247.1
Total Expected Value Opportunities	($13.9)	-2.3	($17.8)	-2.3
Total EV Impact	$730.2	264.4	$794.5	244.9





Risk Summary Sheet

Status: Active

Project: Pearl Highland Garage, Bus Terminal

Risk ID: DB275 SIT 40.07_02

FTA Risk Category: Requirements

HDOT Requirements

Risk Trigger:

Flowchart Activity Number (s):
275

Issue Number:
<Blank>

Modeling Notes:

Pre-Response Quantification

Probability
90%

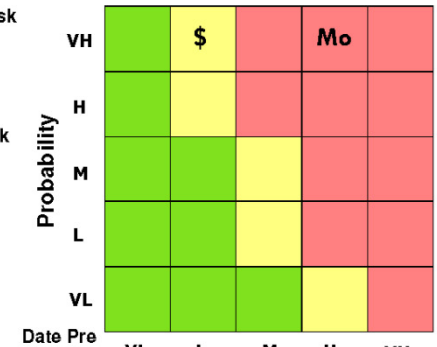
Min ($M)	Most Likely ($M)	Max ($M)	Event Cost Expected Value Impact ($M)	Total Cost Expected Value Impact ($M)	Program Risk Rank
$1.000	$2.000	$4.000	**$1.950**	**$9.402**	18

Min (MO)	Most Likely (MO)	Max (MO)	Schedule Expected Value Impact (MO)	Delay Cost* Calculated EV Impact ($M)	Project Risk Rank
6.00	12.00	18.00	**10.80**	**$7.452**	2

☑ Critical Path Pre

HDOT does not approve of the Design Builders design and requires revisions that add costs. This risk has occurred on other project that interface HDOT and include items such as structures, traffic signals, street lights, guard rails, drainage, and etc.

Cost: Threat
Schedule: Threat



Date Pre Last Updated 12/20/2016

Post-Response Quantification

Probability
75%

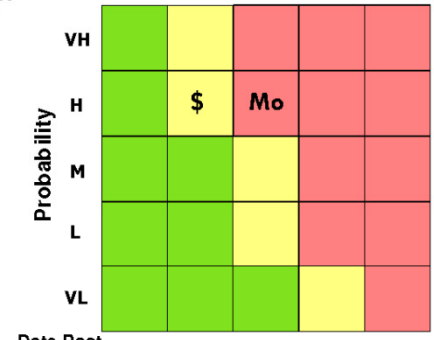
Min ($M)	Most Likely ($M)	Max ($M)	Event Cost Expected Value Impact ($M)	Total Cost Expected Value Impact ($M)	Additional Cost to Respond
$1.000	$2.000	$4.000	**$1.625**	**$5.938**	$0.000

Min (MO)	Most Likely (MO)	Max (MO)	Schedule Expected Value Impact (MO)	Delay Cost* Calculated EV Impact ($M)	Strategy
6.00	8.00	12.00	**6.25**	**$4.313**	Mitigate

☑ Critical Path Post

Prior to release of RFP, work with HDOT to an agreeable solution that may require revisions to the conceptual design. Define an order of work for the signal review and approval process by HDOT and DTS to be an initial deliverable of the contract. Include a specific date that the Design Builder will be required to meet. Continue Executive level pressure for timely approvals.

Cost: Threat
Schedule: Threat



Date Post Last Updated 12/20/2016

Monitoring & Control

Risk Owner: John Moore

Review Comments:

Risk Aging
From Date **To Date** 11/1/2018

Status Interval
Monthly
Last Review

Risk Assignment
Owner
Date MC Last Updated 12/21/2016
Next Review

**fixed monthly calculated delay cost impacts*

Honolulu Rail Transit Project

Appendix D: Ryder Levett Bucknall USA Quarterly Construction Cost Report, Fourth Quarter 2016

RLB Rider Levett Bucknall

USA REPORT

AT A GLANCE

2016 was another successful year for the US construction industry. Construction Put-in-Place increased (again), construction unemployment was down and the AIA's Architecture Billing Index clung to positive territory (in November).

As 2017 kicks off, the United States awaits the inauguration of Donald J. Trump as President. While one might speculate on what might happen under a Trump Administration, one can at least look at Trump's Contract with the American Voter for general direction.

On the plus side for construction are promises for less regulation, removing roadblocks from energy infrastructure projects, the introduction of the American Energy & Infrastructure Act and the end to the sequester on defense spending.

On the negative side for construction are the potential fall-outs from cracking down on immigration and suspending Federal funding for 'sanctuary cities'.

In the 'unknown' category are the medium term effects of the proposed Middle Class Tax Relief and Simplification Act (short term the proposed tax cuts will likely be good for construction), the repeal and replacement of the Affordable Healthcare Act, the labeling of China as a 'currency manipulator' and the renegotiation of NAFTA or withdrawal from it.

On balance, Rider Levett Bucknall expects that, barring some external shock to the economy, 2017 should be another positive year for construction generally.

NLAND SURF PARK
AUSTIN, TX

NLand is North America's first surf park and resort featuring waves for pros and novices alike in a lagoon the size of nine football fields. With a deep commitment to sustainability, a state-of-the art water catchment system was designed to ensure guests only surf on raindrops. Rain is channeled through s system of pipes and trenches into a wet pond where it is bio-filtered before it moves to a deep reservoir for storage and eventually through a filtration system to replenish the lagoon. NLand partnered with Spanish engineering firm Wavegarden, widely considered the world leader in wave technology.

RLB acted as Owner's Representative and Project Manager in all stages of the project, leading the teams responsible for NLand's design and construction. Responsibilities included providing tailored and flexible strategic cost planning during pre-construction and project milestones, as well as project management throughout construction and close-out. RLB's role included advising on construction contracts, preparation of construction bid packages, analysis and recommendation of contractors and collaboration with the design team.

USA REPORT

NATIONAL CONSTRUCTION COST INDEX

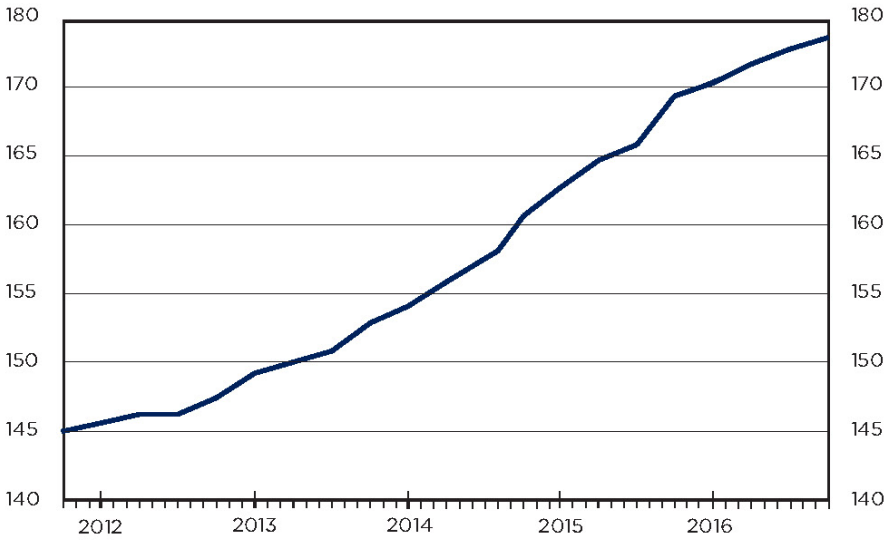
The National Construction Cost Index shows the changing cost of construction between October 2011 and October 2016, relative to a base of 100 in April 2001. Index recalibrated as of April 2011.

Date	Cost Index
October 2011	145.29
January 2012	145.73
April 2012	146.35
July 2012	146.67
October 2012	147.74
January 2013	149.19
April 2013	150.75
July 2013	151.89
October 2013	153.09
January 2014	154.56
April 2014	156.33
July 2014	158.48
October 2014	161.11
January 2015	162.98
April 2015	164.96
July 2015	166.85
October 2015	169.05
January 2016	171.38
April 2016	173.84
July 2016	176.48
October 2016	178.34

Welcome to the fourth quarter 2016 issue of Rider Levett Bucknall's Quarterly Cost Reports! This issue contains data current to October 1, 2016.

According to the U.S. Department of Commerce, construction put-in-place during October 2016 was estimated at a seasonally adjusted annual rate of $1,150.0 billion, which is 0.4% below the revised August estimate of $1,154.4 billion. The September 2016 figure is 0.2% below the September 2015 estimate of $1,152.1 billion. The value of construction for the first nine months of this year was $863.2 billion, 4.4% above the same period in 2015.

NATIONAL CONSTRUCTION COST INDEX



KEY UNITED STATES STATISTICS

	Q4 2015	Q1 2016	Q2 2016	Q3 2016
Gross Domestic Product (GDP)*	1.4%	0.8%	1.1%	3.2%
Consumer Price Index (CPI)	236.5	238.1	241.0	241.4
Inflation (Quarter)	-0.60%	0.68%	1.22%	0.16%
Architectural Billings Index (ABI)	50.9	51.9	52.6	48.4
Construction Put-in-Place (B)	$1,116.6	$1,133.9	$1,133.5	$1,150.0
Unemployment	5.0%	4.9%	4.9%	4.5%
Construction Unemployment	7.5%	8.7%	4.6%	5.2%

GDP represented in percent change from the preceding quarter, seasonally adjusted at annual rates. CPI quarterly figures represent the monthly value at the end of the quarter. Inflation rates represent the total price of inflation from the previous quarter, based on the change in the Consumer Price Index. ABI is derived from a monthly American Institute of Architects survey of architectural firms of their work on the boards, reported at the end of the period. Construction Put-in-Place figures represent total value of construction dollars in billions spent at a seasonally adjusted annual rate taken at the end of each quarter. General Unemployment rates are based on the total population 16 years and older. Construction Unemployment rates represent only the percent of experienced private wage and salary workers in the construction industry 16 years and older. Unemployment rates are seasonally adjusted, reported at the end of the period.

Sources: U.S. Bureau of Labor Statistics, Bureau of Economic Analysis, American Institute of Architects

** Adjustments made to GDP based on amended changes from the Bureau of Economic Analysis.*

USA REPORT

INDICATIVE CONSTRUCTION COSTS

The data in the chart below represents estimates of current building costs in each respective market. Costs may vary as a consequence of factors such as site conditions, climatic conditions, standards of specification, market conditions, etc. Values represent hard construction costs based on U.S. dollars per square foot of gross floor area.

	OFFICES				RETAIL SHOPPING				HOTELS				HOSPITAL		INDUSTRIAL		PARKING				RESIDENTIAL				EDUCATION					
	PRIME		SECONDARY		CENTER		STRIP		5 STAR		3 STAR		GENERAL		WAREHOUSE		GROUND		BASEMENT		MULTI-FAMILY		SINGLE-FAMILY		ELEMENTARY		HIGH SCHOOL		UNIVERSITY	
LOCATION	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH
Boston	300	475	200	300	175	275	125	200	375	550	250	375	400	650	100	175	75	125	90	150	175	300	250	350	275	375	285	400	325	475
Chicago	230	360	165	240	135	225	115	165	290	485	190	240	360	595	100	140	70	110	90	140	130	320	150	325	220	350	220	380	250	385
Denver	160	255	115	175	90	145	70	135	200	310	150	185	370	455	90	150	50	70	90	120	85	190	90	400	245	300	260	310	285	400
Honolulu	285	530	245	400	210	495	175	435	515	745	325	545	475	760	145	225	100	145	140	265	195	445	280	760	340	475	405	610	445	720
Las Vegas	140	295	105	190	115	480	65	145	350	500	150	300	285	455	50	100	50	85	60	150	70	405	90	350	180	315	200	455	235	455
Los Angeles	210	315	145	220	130	295	105	170	315	470	210	290	420	630	100	170	100	120	115	165	160	260	160	325	325	430	340	470	360	515
New York	375	575	300	400	275	425	175	300	400	600	300	400	475	700	115	200	95	175	125	200	200	375	275	400	290	400	300	450	325	475
Phoenix	160	275	110	175	110	170	80	140	300	475	150	250	300	450	55	100	45	70	60	110	90	185	100	400	170	250	200	300	250	400
Portland	180	250	130	180	140	240	120	180	190	275	150	190	380	525	90	150	85	105	110	150	150	240	125	280	235	295	250	310	280	400
San Francisco	200	350	180	275	195	325	225	325	300	500	250	350	400	525	140	190	100	130	165	190	280	425	200	400	320	400	300	375	250	375
Seattle	195	240	130	190	135	305	110	155	225	325	215	230	370	525	90	125	80	100	120	155	145	250	150	270	240	295	265	455	310	460
Washington, D.C.	275	425	200	300	150	275	125	175	350	525	250	350	400	650	90	150	70	125	80	125	175	300	250	350	275	350	275	375	325	475

ECONOMIC INDICATOR - BALTIC DRY INDEX

WHAT IS THE BALTIC DRY INDEX?

The Baltic Dry Index ("BDI") is a weighted index, calculated daily, measuring the supply of bulk dry carriers and considers shipping routes and volumes for four different categories of cargo ships. It does not consider ships carrying containers or ships carrying "energy liquids".

BDI is considered to be a 'leading' economic indicator because it measures the transportation cost of materials used in finished goods and is therefore a gauge of short-term economic activity.

WHAT DOES BDI TELL US?

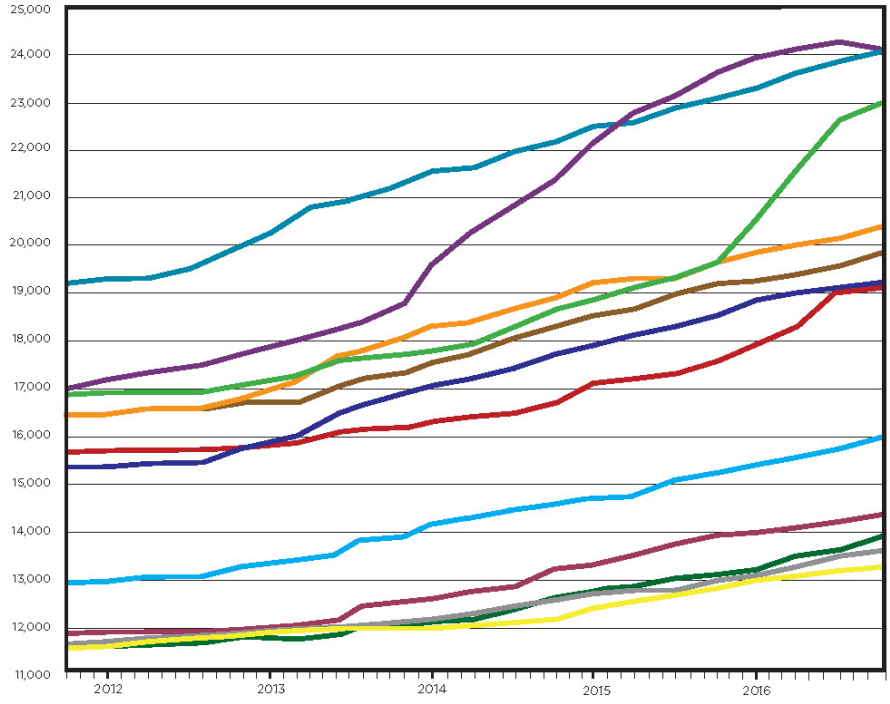
The BDI is seasonal and has well observed annual peaks and troughs so short term trends can be hard to interpret. Nevertheless, over the medium and longer term, BDI does provide a useful insight into global demand for commodities and it is fair to say that it continues to reflect the bull market for commodities without signs (yet) of an upturn.

BALTIC DRY INDEX 2009-2016

Source: Lloyd's List

USA REPORT

COMPARATIVE COST INDEX



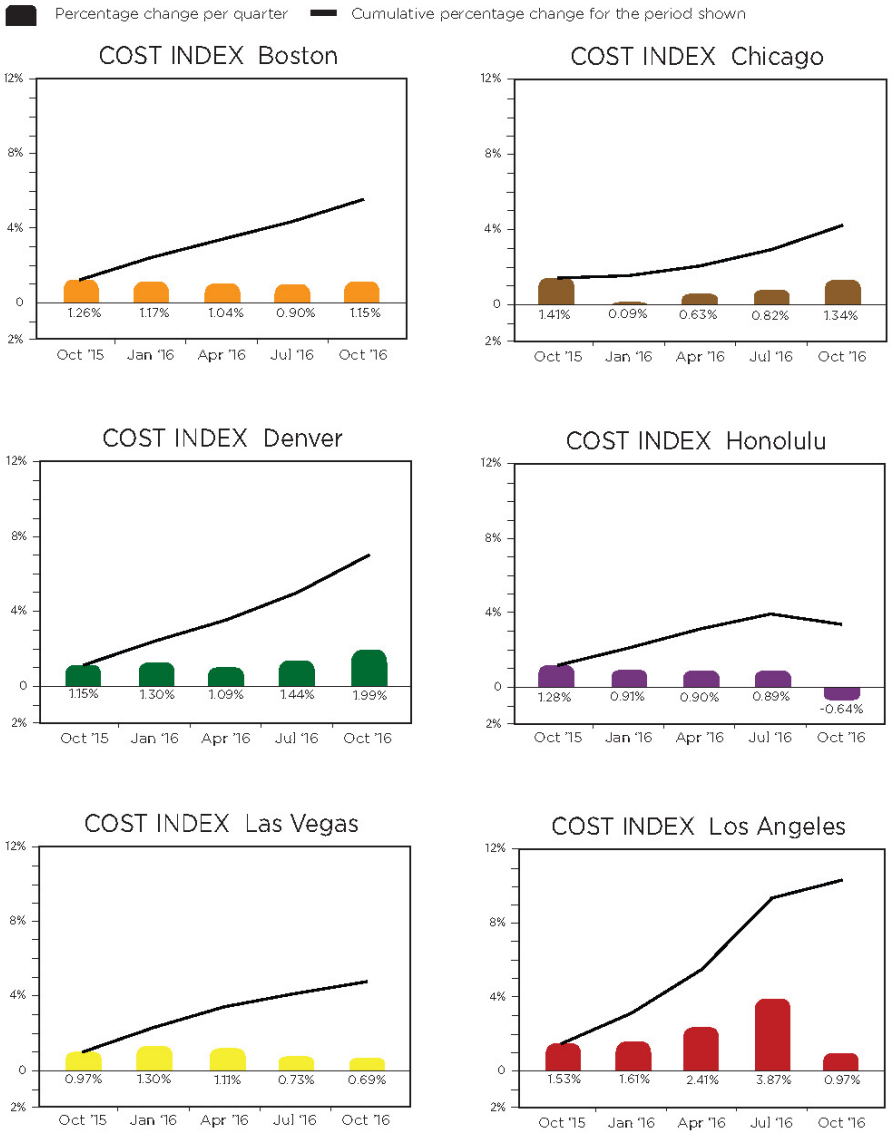
Each quarter we look at the comparative cost of construction in 12 US cities, indexing them to show how costs are changing in each city in particular, and against the costs in the other 11 locations. You will be able to find this information in the graph titled *Comparative Cost Index (above)* and in the *Cost and Change Summary (right)*.

Our Comparative Cost Index tracks the 'true' bid cost of construction, which includes, in addition to costs of labor and materials, general contractor and sub-contractor overhead costs and fees (profit). The index also includes applicable sales/use taxes that 'standard' construction contracts attract. In a 'boom,' construction costs typically increase more rapidly than the net cost of labor and materials. This happens as the overhead levels and profit margins are increased in response to the increasing demand. Similarly, in a 'bust', construction cost increases are dampened (or may even be reversed) due to reductions in overheads and profit margins.

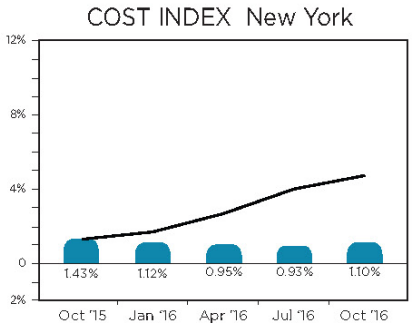
City	July 2016	October 2016	% Change
Boston	20,257	20,489	1.15%
Chicago	19,547	19,809	1.34%
Denver	13,660	13,932	1.99%
Honolulu	24,338	24,181	-0.64%
Las Vegas	13,251	13,342	0.69%
Los Angeles	19,041	19,225	0.97%
New York	23,837	24,101	1.10%
Phoenix	13,481	13,578	0.72%
Portland	14,287	14,469	1.28%
San Francisco	22,625	23,005	1.68%
Seattle	15,774	15,972	1.26%
Washington, DC	19,163	19,376	1.11%

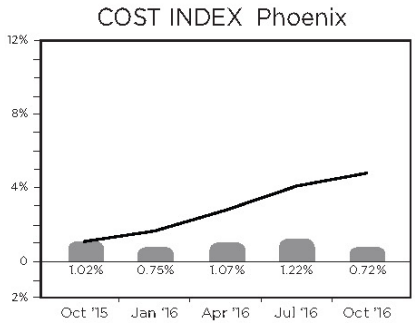
Our research suggests that between July 1, 2016 and October 1, 2016 the national average increase in construction cost was approximately 1.0%. Several locations saw increases over 1% in the quarter however Las Vegas, Los Angeles and Phoenix all experienced increases below 1% and Honolulu, for the first time in over six years, saw a slight decrease.

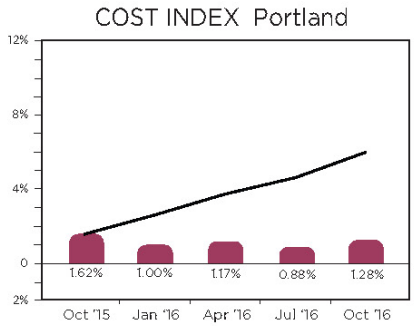
The following escalation charts track changes in the cost of construction each quarter in many of the cities where Rider Levett Bucknall offices are located. Each chart illustrates the percentage change per period and the cumulative percentage change throughout the charted timeline.

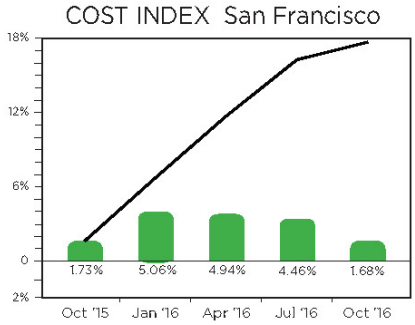


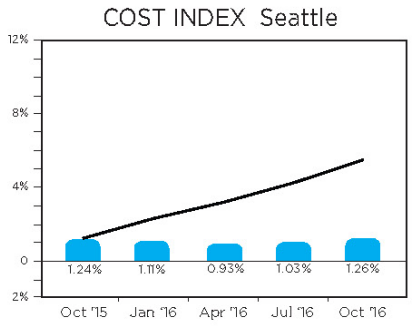
USA REPORT

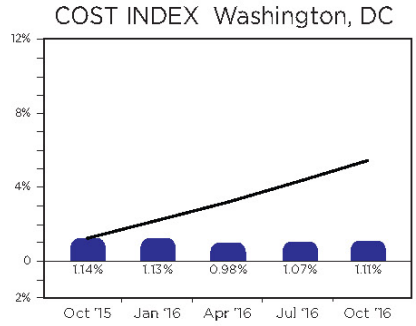












This issue was compiled by Taryn Harbert with contributions from Evans Pomegas, Grant Owen, Jim Bergstrand, Edd Hamzanlui, Paul Brussow, Maelyn Uyehara, Cassie Idehara, Simon James, Philip Mathur, Scott Macpherson, Graham Roy, Daniel Junge, George Bergeron, Steve Kelly, and Catherine Stoupas.

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Cayman Islands | Denver | Guam | Hilo | Honolulu
Las Vegas | Los Angeles | Maui | New York | Phoenix
Portland | San Francisco | Seattle | St. Lucia |
Toronto | Tucson | Waikoloa | Washington, DC
www.rlb.com

Appendix E: Andrew S. Robbins Curriculum Vitae

Andrew S. Robbins, P.E.

Education:	Master of Science in Industrial Engineering Engineering Management Program (Management of Large Engineering & Construction Projects) University of Pittsburgh Pittsburgh, PA USA
	Bachelor of Science in Electrical Engineering Minor in Urban Studies (Urban Planning & Transportation Economics) Lehigh University Bethlehem, PA USA
Professional Registrations:	Registered Professional Engineer, State of Hawaii PE-8125 Professional Engineer, Commonwealth of Pennsylvania
Personal attributes:	Dedicated; innovative; leads, strives for excellence

Professional Summary:

Seasoned Rail Transit Executive with substantial international experience in public passenger urban rail, rail equipment & infrastructure, airport transit, construction and engineering. Extensive experience in customer relations, contracts, public-private partnerships & project finance, project management, engineering, installation, construction, operations & maintenance, professional speaking, bids and proposals, and technical and commercial negotiations. Strategic thinker in the area of public works, cities and urban issues with a focus on transportation.

Expert in driverless transit systems including project management, project engineering, systems engineering, systems integration and operations & maintenance, and business development. Extensive experience in Engineering-Procurement-Construction projects (Design-Build-Operate-Maintain) and Public-Private Partnerships (P3) project development.

Summary of Work Experience:

Bombardier Transportation, San Francisco, CA USA

Senior Director - Head of Business Development, Automated Systems – Americas, 2015- Present

Responsible for a team of Business Development Directors and Managers located in Canada, Brazil and USA. Leadership, management, and business development responsibility for all systems projects throughout the Americas. Providing training, forecasting and reporting.

This business development role requires me to understand the background of major transportation projects and endeavors, and to understand the context of how a transportation solution will fit into the urban, airport or other major activity center environment and "ecosystem." It encompasses developing total project solutions at the front end of projects during a pre-project period that typically lasts between one and two years. It requires understanding and mapping of all major stakeholders (government at the federal, state and local level, elected officials, business, community, etc.) and their needs and goals for the project, a thorough analysis of both public and private sector risks and development of associated mitigations to those risks, an understanding of the contractors, suppliers and others who will take on many of the project risks and who become essential partners in project development, and then developing comprehensive solutions to ensure on-time and on-budget and overall project success. My business development role has also afforded me the ability to develop relationships with senior political, business, community and other key stakeholders. The role also includes the formation of engineering-procurement-construction teams and operations & maintenance teams who can respond to and provide comprehensive solutions to specific rail transit projects.

Major Projects and Achievements: 1) Developed, negotiated and executed contracts for expansions of an automated transit system in San Francisco and an automated rail transit system in Vancouver, B.C. 2) Leading business development teams in Canada, USA and Latin America in identifying high-priority projects to fulfill the company's commercial plan for the Americas region.

My current work and highest priority endeavor is as Business Development lead in regard to a new Public-Private Partnership (P3) Project at the Los Angeles International Airport (LAX) which will be executed under a groundbreaking 30 year concession agreement and at a value of approximately US$2.5B billion. The LAX project is one of the early examples in the United States of a comprehensive P3 implementation involving competing consortiums vying for a contract with the Los Angeles World Airports to design-construct-finance-operate and maintain an automated transit system. Over the past two years, I have been developing relationships with key stakeholders in Los Angeles in understanding their needs as the Project takes shape and advances in its development. I am involved with crafting a total system solution that will execute this project over the 30 year term of the Contract. In doing so I am working closely with a team of engineers, contractors, legal experts, financial experts and community relations, workforce development and public outreach experts in order to best position our consortium to meeting all the needs of Los Angeles World Airports, the City of Los Angeles, their customers and stakeholders and the surrounding community..

Bombardier Transportation, Hong Kong & China

Head of Business Development – North Asia Region, 2013- 2015

Responsible for a team of Business Development Directors and Managers located in China, Hong Kong and Taiwan. Management, direct business development responsibility for all systems projects in China, Hong Kong. Korea and Taiwan. Providing leadership to Bid Teams, Technical Support team in Beijing and managing Spare Parts and After-Market Sales Teams. Providing training, forecasting and reporting.

Major Projects and Achievements: 1) Negotiation and formation of a new China joint venture for execution, manufacturing and delivery of Automated People Mover (APM) and Monorail projects in China. China JV established in 2014.

A major accomplishment of mine was in providing overall team leadership in regard to the first new urban automated line in Shanghai valued at over US$300 million. In an efforts lasting nearly three years, I was intensely involved with meeting the Shanghai Metro transit agency and understanding their needs, and developing a "turnkey" procurement methodology that was recommended to and adopted by the agency (first use of turnkey procurement in Shanghai.) I was then a lead participant for my company in developing a joint venture between my company and our Chinese partner who then became the entity responsible for proposing on and executing the project. We developed a total project solution in response to the agency's Request for Proposal.

I was selected by both the Chinese and Western joint venture partners to lead all technical negotiations for the bidding consortium resulting in award of a turnkey contract in 2015 for Shanghai's first ever driverless transit system.

Director, Business Development – Asia-Pacific, 2012-2013

Major Project: Provided business leadership and negotiated contract for new rail transit vehicles in Singapore.

Bombardier Transportation, San Francisco, CA

Head of Systems Business Development – Americas Region, 2008-2012

Located in San Francisco, responsible for a team of Business Development Directors and Managers located in Canada, Mexico and USA. Management and direct business development responsibility for all systems projects in the Americas.

Projects/Proposals included US$400 million BART/Oakland APM , US$1.2B (Core Systems) Honolulu Rapid Transit, US$5B XpressWest high speed rail P3 project, Las Vegas Monorail Extensions, Vancouver Metro vehicles, various APM and O&M contracts. Managed resources performing business development activities in Latin America and bidding and securing the US$1.2B 25 km Sao Paulo Monorail project (a fully driverless, high-capacity urban rail transit system using monorail technology.)

Director, Project Development - Transit Systems– January 2003 to 2008

Located in San Francisco, responsible for project development, and proposal leadership in the automated transit segment, for projects located in Western North America and Asia-Pacific. Responsibilities included teaming, negotiations, technical and commercial proposal development for large design-build-operate-maintain projects.

Major accomplishments included the formation and management of a construction, engineering, finance and rail system supplier consortium to propose and bid on the Vancouver Canada Line project, an early Public-Private Partnership (P3) procurement involving finance-design-build-operate-maintain of a 30 km driverless urban rail system in Vancouver, B.C.

Other major accomplishments included the development, proposal, bid and negotiation of a contract for the Guangzhou, China Urban Automated Transit System (the first urban driverless system in China). Efforts included forming the project structure and project organization, and launching the project execution team resulting in the successful completion and operation of this system.

Director, Private Rail Projects – Americas & Asia-Pacific, August 2001 – December, 2002

Located in Oakland, CA, responsible for screening, structuring and management of projects in the emerging market for Public-Private Partnership solutions for rail transit development. This included identifying teaming, workscope and commercial terms and conditions, and establishing project development efforts, including leadership in the development of proposals. Negotiated two contracts for driverless transit systems located at the McCarran Las Vegas International Airport.

DaimlerChrysler Rail System (known as "Adtranz"), Pittsburgh, PA

Vice President, Business Development, April 1994 – July 2001

Responsible for screening and structuring design-build-operate-maintain projects, developing strategies and business plans, developing proposals and negotiating contracts. Project experience included the automated transit system projects and contracts secured at the London Heathrow, Rome, Kuala Lumpur, Orlando, Houston and San Francisco International airports. Led the development and tendering activities on behalf of an international consortium bidding to the Singapore Land Transport Authority for the US$205M Bukit Panjang, Singapore automated light rapid transit system which entered service in November, 1999.

Program Manager, Programs and Contracts Department, December, 1991 - March, 1994

Program Manager on-site in Honolulu, Hawaii, US$300M electrical/mechanical and operations & maintenance portions of a US$1.1B turnkey contract for a new urban rapid transit system. I led the development of the operating system preliminary engineering, and operations & maintenance planning. My role as Program Manager also involved working closely with a team of engineers, contractors, planners and others in a co-located office as we began to execute and form a total project solution for the US1.1B contract. This work involved preliminary designs for the guideway, stations, maintenance facility and other fixed facilities. We met and worked with the Federal Transit Administration (FTA) in regard to their oversight of the project. We met and worked with various consultants responsible for oversight and analysis of our solution. Various meetings and negotiations with City and County of Honolulu were conducted, including design reviews, budgeting, scheduling and public relations efforts. I participated in several meetings with elected officials including the Mayor, Managing Director and City Council. The project progressed through completion of preliminary engineering.

Prior to 1991, I held positions at Adtranz and Westinghouse Electric Corporation/Transportation Division, in engineering, engineering management, and operations & maintenance.

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Appendix F: Basis of Cost Estimate

Honolulu Rail Transit Project
East Kapolei Station to Ala Moana Center Station
Basis of Estimate

Table of Contents

Appendices

Acronyms and Abbreviations

AGS	Airport Guideway and Stations
BOE	Basis of Estimate
CCGS	City Center Guideway and Stations
CSC	Core Systems Contractor
DB	Design-Build
DBB	Design-Bid-Build
DPP	City and County of Honolulu, Department of Planning and Permitting
EAC	Estimate at Completion
FFGA	Full Funding Grant Agreement
FHSG	Farrington Highway Station Group
FTA	Federal Transit Administration
HART	Honolulu Authority for Rapid Transportation
HRTP	Honolulu Rail Transit Project
ICE	Independent Cost Estimate
KHG	Kamehameha Highway Guideway
KHSG	Kamehameha Highway Station Group
MOS	Minimum Operable Segment
MSF	Maintenance and Storage Facility
PHGT	Pearl Highlands Garage and Transit Center
PM	Project Manager
ROC	Rail Operations Center
ROM	Rough Order of Magnitude
ROW	Right-of-Way
RSD	Revenue Service Date
SCC	Standard Cost Category
WOFH	West O'ahu/Farrington Highway Guideway
WOSG	West O'ahu Stations Group
YOE	Year of Expenditure

1 Introduction

This Basis of Estimate (BOE) document describes the capital cost estimate methodology and assumptions used to develop the Honolulu Rail Transit Project (HRTP or the Project) Estimate at Completion (EAC) as approved by the executed Full Funding Grant Agreement (FFGA) dated December 12, 2012.

The HRTP consists of a 20.1-mile fixed rail system on elevated guideway structure from East Kapolei to Ala Moana Center, 20 elevated stations, 1 at-grade station, a Rail Operations Center (ROC, formerly known as the Maintenance and Storage Facility [MSF]) and service yard, parking facilities, intermodal facilities, utilities, roadway improvements, all system work, right-of-way (ROW) acquisition, relocations, 80 driverless rail vehicles, and complete professional services, including design, construction management, and owner costs. The Project is divided in multiple contracts.

The Project is approximately 38% complete, which includes completion of the ROC and 10.75 miles of elevated guideway constructed from the East Kapolei Station site to just past the Aloha Stadium Station site. It should be noted that the reported percentages complete are based on the current EAC and estimated Revenue Service Date (RSD) of December 2025.

With the recent award of the Airport Guideway and Stations (AGS) Design-Build contract, the Honolulu Authority for Rapid Transportation (HART) currently has over $4.3 billion either completed or under contract, which includes 15.9 of the 20.1 miles of guideway and 13 of the 21 stations. The two most significant contract packages yet to be awarded are the City Center Guideway and Stations (CCGS) Design-Build package and the Pearl Highlands Garage and Transit Center (PHGT) Design-Build package; both are scheduled to be procured in 2018.

2 HRTP Minimum Operable Segment

The Capital Cost Estimate reflects the cost for the HRTP 20.1-mile rail transit system extending from East Kapolei at the west terminus to Ala Moana Center at the east terminus via Pearl Harbor, the Honolulu International Airport, and downtown Honolulu, otherwise referred to as the Minimum Operable Segment (MOS). Revenue service for the MOS is expected to be December 2025.

3 Estimate Overview

3.1 Summary of Cost

The current Capital Cost Estimate is $8.165 billion which includes $1.1 billion of allocated and unallocated contingency, all in Year of Expenditure (YOE) dollars. A summary of the estimated costs for the Project is provided in the table below:

Table 3-1 Cost Summary

Cost Summary	Estimate at Completion
Construction (SCC 10-50)	$ 5,238,076,258
ROW (SCC 60)	263,522,643
Vehicles (SCC 70)	211,661,870
Professional Services (SCC 80)	2,178,152,556
Unallocated Contingency	273,641,000
Total Capital Project (excludes finance costs)	$8,165,084,000

3.2 Cost Estimating Methodologies

The cost estimating methodologies used to estimate future costs in the EAC vary from contract to contract, depending on level of design and its intended budgetary use. The following provides a general description of the different estimating methodologies for cost estimates used in the various cost models and updates in the Capital Cost Estimate:

- Independent Cost Estimate (ICE): A cost estimate that is developed by one or more estimators, or estimating teams, not directly associated with the subject task or project to serve as a tool for an independent cost analysis. An ICE is often prepared to create budgets for future projects, develop negotiation strategies for change orders, and establish engineer's estimate ranges prior to advertisement.

- Rough Order of Magnitude (ROM) Estimate: An estimate developed to facilitate project budgetary and feasibility determinations. Quantity information for a ROM estimate is often based on parametric units (for example, route feet, lane miles, gross square feet, number of parking stalls). Pricing is based on historical costs with adjustments made for project location, size, or capacity differences, and cost escalation.

- Validation Estimate: A Validation Estimate is a review of an ICE in order to check the ICE for validity and accuracy. A Validation Estimate will often be performed in a much shorter timeframe, utilizing the quantity takeoffs and format that the ICE has established. A Validation Estimate will often focus on the 20% of the bid items that make up 80% of the costs.

- Bottom-up Risk Assessment: HART's Risk Manager has performed several bottom-up risk assessments for the HRTP. This process evaluated all base costs and schedules for

each of the projects in the program. A network risk model was created to define how a risk on one project in the program affects other projects. Multiple probability outcomes are generated from the assessment for each contract package and for the overall Project.

3.3 Capital Cost Estimate Development

Multiple methodologies were also applied to determine the basis of current estimates for awarded and future contracts. Methodologies differ depending on whether a project is an awarded contract, unawarded contract, professional services contract, or other soft cost.

Actual values of awarded construction contracts were used for the West O'ahu/Farrington Highway (WOFH), Kamehameha Highway Guideway (KHG), AGS, and MSF Design-Build contracts; the West O'ahu Station Group (WOSG), Farrington Highway Station Group (FHSG), and Kamehameha Highway Station Group (KHSG) Design-Bid-Build contracts; and the Core Systems Contractor (CSC) Design-Build-Operate-Maintain contract. All bid values were adjusted and sorted by the appropriate Standard Cost Category (SCC) for these estimates.

Additional data sources used for factoring the EAC includes staffing projections, change orders in negotiations with contractors, merit changes under evaluation, known risks with potential cost or schedule impacts, and contingency to account for unknown site conditions, unresolved design or scope issues, market fluctuations, regulatory requirements and schedule impacts.

The methodology and source data for each category of cost basis are identified below:

- Active Construction Contracts: The development of the base cost updates for active contracts reflects Current Contract Value as of December 30, 2016. The Current Contract Value reflects any executed binding obligations entered into for goods and services by HART. This includes the total of actual contracts awarded, and executed change orders or amendments; third-party commitments, offers accepted for purchase of real estate, and other HART actions which have been spent or result in the obligation of specific expenditures at a future time.

- Unawarded Construction: An ICE was developed for the PHGT; Park-and-Ride Lots Construction; and City and County of Honolulu Department of Planning and Permitting (DPP) Design Review. For the CCGS contract, an ICE was completed, and a Validation Estimate was developed for the completed ICE. The remaining unawarded contracts are quantified by various levels of ROM estimates provided by HART estimators or Project Managers (PMs).

- Professional Services and Other Contracts: Staffing plan estimates have been provided by HART estimators and PMs based on the assumed substantial completion dates of each associated contract package.

3.4 FTA Standard Cost Categories (SCCs)

As required by the Federal Transit Administration (FTA), HART uses the FTA's Standard Cost Categories (SCCs) to summarize the individual contract packages into a comprehensive Total Project estimate. A description of the major cost components includes the following:

3.4.1 SCC 10 through SCC 80

The HRTP estimated base scope is summarized in codes SCC 10 through SCC 80. These elements include Guideway, Stations, Support Facilities, Systems, Vehicles, ROW, Utilities, Art, and Professional Services. As previously referenced, the Project cost estimate is comprised of both active awarded base scope cost and unawarded base scope. Change work or extended services for professional services that is determined to be an imminent change order, but not yet committed under contract, has been included as base cost in the Project cost estimate.

3.4.2 SCC 90: Contingency

This Project cost estimate includes allocated contingency for active contract packages and unawarded contract packages, as well as unallocated contingency reserve for the entirety of the HRTP. Contingency in this Project cost estimate is informed by the outcome of a bottom-up risk assessment completed by utilizing HART's internal risk model and a comprehensive validation of the model's output from the respective PMs. The allocated contingency varies from contract to contract. Unallocated contingency is based on 3% of the total of codes SCC 10 through SCC 80.

HART's Risk Manager performed a bottom-up risk assessment in August 2016 for every project in the program. This process evaluated every base cost and schedule for each of the contract packages in the program. This resulted in a variety of probability outcomes for the HRTP EAC and identified the level of contingency associated with each EAC. The risk program ultimately modeled for an EAC at a P80, which was used as a basis for the overall program contingency. Each respective contract package took what was modeled at a P65 to assist in informing the appropriate value of allocated contingency. The difference between the P80 and P65 values helped to determine the unallocated contingency.

In January 2017, HART undertook a validation of the EAC. This validation built upon what was modeled in August 2016 by reflecting updated cost estimates and adjusted risks where applicable. Contingencies were redistributed or added based on current information provided by the respective project teams either through updated forecast projections and/or updated risk information identified in the risk model.

3.4.3 SCC 100: Finance Charges

This SCC code is reserved for finance charges that will be incurred due to borrowing required to complete the MOS. Estimated finance costs, and the method by which it was derived, are detailed in the revised Financial Plan.

4 Estimate Assumptions

The following is a list of key assumptions/qualifications:

- Labor rates are current Davis-Bacon Wages with fringes, prevailing wage rates for the State of Hawai'i.
- Buy America requirements apply.
- Costs for unawarded contracts are based on a competitive bid environment, with a minimum of three proposers/bidders anticipated.
- There are sufficient experienced contractors available to perform the future work in the Honolulu construction marketplace.
- All costs are in YOE dollars.
- The anticipated RSD is December 2025.
- Risks for market conditions were included in the risk profiles to account for unique escalation for materials and labor.

5 Sources of Data

The costs included in the overall Project estimate are derived from multiple sources, including the following:

- Current contract values on active HRTP contracts as of December 2016
- Forecast Cost Report with Details as of December 2016
- HART internal Risk Model output, updated in January 2017
- Local vendor quotations
- Historical HART Bid Data
- RS Means database
- State of Hawai'i Davis-Bacon Wage Rates
- Blue Book equipment rates

Appendix A: Base Cost Estimate by Standard Cost Category

City and County of Honolulu
Honolulu Rail Transit Project
Plan A (East Kapolei to Ala Moana Center)

Estimate at Completion by Standard Cost Category

Applicable Line Items Only		YOE Dollars Total
10 GUIDEWAY & TRACK ELEMENTS		**$1,695,619,976**
10.02	Guideway: At-grade semi-exclusive (allows cross-traffic)	$17,378
10.04	Guideway: Aerial structure	$1,542,893,392
10.05	Guideway: Built-up fill	$4,687,196
10.09	Track: Direct fixation	$124,024,234
10.12	Track: Special (switches, turnouts)	$2,506,181
10.13	Track: Vibration and noise dampening	$21,491,594
20 STATIONS, STOPS, TERMINALS, INTERMODAL		**$916,959,112**
20.01	At-grade station, stop, shelter, mall, terminal, platform	$13,461,505
20.02	Aerial station, stop, shelter, mall, terminal, platform	$644,188,960
20.04	Other stations, landings, terminals: Intermodal, ferry, trolley, etc.	$42,838,547
20.06	Automobile parking multi-story structure	$149,186,940
20.07	Elevators, escalators	$67,283,159
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS		**$120,015,787**
30.01	Administration Building: Office, sales, storage, revenue counting	$231,250
30.02	Light Maintenance Facility	$7,582,704
30.03	Heavy Maintenance Facility	$46,317,810
30.04	Storage or Maintenance of Way Building	$8,892,739
30.05	Yard and Yard Track	$56,991,284
40 SITEWORK & SPECIAL CONDITIONS		**$2,181,062,067**
40.01	Demolition, Clearing, Earthwork	$54,634,798
40.02	Site Utilities, Utility Relocation	$765,966,674
40.03	Haz. mat'l, contam'd soil removal/mitigation, ground water treatments	$9,006,406
40.04	Environmental mitigation, e.g. wetlands, historic/archeologic, parks	$12,570,587
40.05	Site structures including retaining walls, sound walls	$107,183,053
40.06	Pedestrian / bike access and accommodation, landscaping	$18,838,502
40.07	Automobile, bus, van accessways including roads, parking lots	$154,229,177
40.08	Temporary Facilities and other indirect costs during construction	$1,058,632,870
50 SYSTEMS		**$324,419,317**
50.01	Train control and signals	$163,651,692
50.03	Traction power supply: substations	$34,942,281
50.04	Traction power distribution: catenary and third rail	$32,475,378
50.05	Communications	$66,793,234
50.06	Fare collection system and equipment	$22,746,390
50.07	Central Control	$3,810,343
Construction Subtotal (10 - 50)		**$5,238,076,258**
60 ROW, LAND, EXISTING IMPROVEMENTS		**$263,522,643**
60.01	Purchase or lease of real estate	$230,708,269
60.02	Relocation of existing households and businesses	$32,814,374
70 VEHICLES (80)		**$211,661,870**
70.01	Light Rail	$190,383,694
70.05	Other	$400,619
70.06	Non-revenue vehicles	$14,371,344
70.07	Spare parts	$6,506,214
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)		**$2,178,152,556**
80.01	Preliminary Engineering	$112,241,243
80.02	Final Design	$512,666,204
80.03	Project Management for Design and Construction	$799,920,682
80.04	Construction Administration & Management	$298,287,774
80.05	Professional Liability and other Non-Construction Insurance	$139,139,859
80.06	Legal; Permits; Review Fees by other agencies, cities, etc.	$101,873,981
80.07	Surveys, Testing, Investigation, Inspection	$143,151,889
80.08	Start up	$70,870,924
Subtotal (10 - 80)		**$7,891,413,327**
90 UNALLOCATED CONTINGENCY		**$273,640,866**
Subtotal (10 - 90)		**$8,165,054,193**
100 FINANCE CHARGES		**$464,897,000**
Total Project Cost (10 - 100)		**$8,629,951,193**

City and County of Honolulu
Honolulu Rail Transit Project
Plan A (East Kapolei to Ala Moana)

Inflated Cost to Year of Expenditure

STANDARD COST CATEGORY DESCRIPTION	Base Year Dollars w/o Contingency	Base Year Dollars Allocated Contingency	Base Year Dollars TOTAL	Inflation Factor	YOE Dollars TOTAL
10 GUIDEWAY & TRACK ELEMENTS	$1,461,802,684	$198,562,608	$1,659,460,074	1.0218	$1,695,619,976
20 STATIONS, STOPS, TERMINALS, INTERMODAL	$718,997,493	$154,231,209	$882,774,435	1.0387	$916,959,112
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS	$119,400,067		$120,015,787	1.0000	$120,015,787
40 SITEWORK & SPECIAL CONDITIONS	$1,497,835,066	$206,688,898	$2,133,924,890	1.0221	$2,181,062,067
50 SYSTEMS	$289,355,816	$33,348,501	$324,419,317	1.0000	$324,419,317
60 ROW, LAND, EXISTING IMPROVEMENTS	$210,311,604	$32,093,130	$263,522,643	1.0000	$263,522,643
70 VEHICLES	$191,882,721	$19,779,149	$211,661,870	1.0000	$211,661,870
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)	$1,514,775,728	$144,939,061	$2,166,206,311	1.0055	$2,178,152,556
90 UNALLOCATED CONTINGENCY			$260,132,552	1.0519	$273,640,866
100 FINANCE CHARGES*			$464,897,000	1.0000	$464,897,000
Total Project Cost (10 - 100)			**$8,487,014,880**	**1.0168**	**$8,629,951,193**

*Preliminary Finance Costs of $465 Million could significantly increase depending on action taken by the State Legislature regarding the possible extension of the GET Surcharge as well the terms upon which the extension is based.

MAIN WORKSHEET - BUILD ALTERNATIVE

City and County of Honolulu — Today's Date: **Jan 2017**

Honolulu Rail Transit Project, East Kapolei to Ala Moana Center — Yr of Base Year $: Jan 2017

Full Funding Grant Agreement — Yr of Revenue Ops: FY 2026

	Quantity	Base Year Dollars w/o Contingency (X000)	Base Year Dollars Allocated Contingency (X000)	Base Year Dollars TOTAL (X000)	Base Year Dollars Unit Cost (X000)	Base Year Dollars Percentage of Construction Cost	Base Year Dollars Percentage of Total Project Cost	YOE Dollars Total (X000)
10 GUIDEWAY & TRACK ELEMENTS (route miles)	**20.09**	1,461,802,684	198,562,808	**1,659,460,074**	**$ 82,585,882**	**32%**	**20%**	**1,695,619,976**
10.01 Guideway: At-grade exclusive right-of-way		0	0	0				0
10.02 Guideway: At-grade semi-exclusive (allows cross-traffic)		17,378	0	17,378				17,378
10.03 Guideway: At-grade in mixed traffic		0	0	0				0
10.04 Guideway: Aerial structure	19.75	1,328,434,151	185,220,716	1,512,426,867	$ 76,578,576			1,542,893,392
10.05 Guideway: Built-up fill		4,588,992	98,204	4,687,196				4,687,196
10.06 Guideway: Underground cut & cover		0	0	0				0
10.07 Guideway: Underground tunnel		0	0	0				0
10.08 Guideway: Retained cut or fill	0.34	0	0	0	$ -			0
10.09 Track: Direct fixation		110,567,700	9,278,355	120,168,837				124,024,234
10.10 Track: Embedded		0	0	0				0
10.11 Track: Ballasted		0	0	0				0
10.12 Track: Special (switches, turnouts)		2,143,350	295,276	2,438,626				2,506,181
10.13 Track: Vibration and noise dampening		16,051,113	3,670,056	19,721,169				21,491,594
20 STATIONS, STOPS, TERMINALS, INTERMODAL (number)	**21**	718,997,493	154,231,209	**882,774,435**	**$ 42,036,878**	**17%**	**10%**	**916,959,112**
20.01 At-grade station, stop, shelter, mall, terminal, platform	1	11,312,189	2,149,316	13,461,505	$ 13,461,505			13,461,505
20.02 Aerial station, stop, shelter, mall, terminal, platform	20	510,846,856	102,273,467	622,666,056	$ 31,133,303			644,188,960
20.03 Underground station, stop, shelter, mall, terminal, platform		0	0	0				0
20.04 Other stations, landings, terminals: Intermodal, ferry, trolley, etc.		32,300,110	7,713,750	40,013,860				42,838,547
20.05 Joint development		0	0	0				0
20.06 Automobile parking multi-story structure		112,486,416	26,863,439	139,349,855				149,186,940
20.07 Elevators, escalators		52,051,922	15,231,237	67,283,159				67,283,159
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS		119,400,067	0	**120,015,787**	**$ 5,972,792**	**2%**	**1%**	**120,015,787**
30.01 Administration Building: Office, sales, storage, revenue counting		231,250	0	231,250				231,250
30.02 Light Maintenance Facility		7,582,704	0	7,582,704				7,582,704
30.03 Heavy Maintenance Facility		45,702,090	0	46,317,810				46,317,810
30.04 Storage or Maintenance of Way Building		8,892,739	0	8,892,739				8,892,739
30.05 Yard and Yard Track		56,991,284	0	56,991,284				56,991,284
40 SITEWORK & SPECIAL CONDITIONS		1,497,835,066	206,688,898	**2,133,924,890**	**$ 106,198,439**	**42%**	**25%**	**2,181,062,067**
40.01 Demolition, Clearing, Earthwork		45,627,734	8,094,729	53,722,463				54,634,798
40.02 Site Utilities, Utility Relocation		535,135,092	84,679,082	751,833,523				765,966,674
40.03 Haz. mat'l, contam'd soil removal/mitigation, ground water treatments		8,090,543	615,863	9,006,406				9,006,406
40.04 Environmental mitigation, e.g. wetlands, historic/archeologic, parks		11,391,864	1,178,723	12,570,587				12,570,587
40.05 Site structures including retaining walls, sound walls		85,712,643	16,917,020	102,629,663				107,183,053
40.06 Pedestrian / bike access and accommodation, landscaping		16,282,654	2,041,630	18,324,284				18,838,502
40.07 Automobile, bus, van accessways including roads, parking lots		126,477,577	20,421,209	146,898,786				154,229,177
40.08 Temporary Facilities and other indirect costs during construction		669,116,959	72,740,643	1,038,939,178				1,058,632,870
50 SYSTEMS		289,355,816	33,348,501	**324,419,317**	**$ 16,145,285**	**6%**	**4%**	**324,419,317**
50.01 Train control and signals		144,960,783	18,690,909	163,651,692				163,651,692
50.02 Traffic signals and crossing protection		0	0	0				0
50.03 Traction power supply: substations		31,708,553	3,233,728	34,942,281				34,942,281
50.04 Traction power distribution: catenary and third rail		31,333,630	1,141,748	32,475,378				32,475,378
50.05 Communications		61,256,561	5,536,673	66,793,234				66,793,234
50.06 Fare collection system and equipment		16,642,498	4,388,892	22,746,390				22,746,390
50.07 Central Control		3,453,791	356,552	3,810,343				3,810,343
Construction Subtotal (10-50)		4,087,391,127	592,831,216	**5,120,594,503**	**$ 254,835,185**	**100%**	**60%**	**5,238,076,258**
60 ROW, LAND, EXISTING IMPROVEMENTS		210,311,604	32,093,130	**263,522,643**	**$ 13,114,657**		**3%**	**263,522,643**
60.01 Purchase or lease of real estate		181,530,966	29,177,303	230,708,269				230,708,269
60.02 Relocation of existing households and businesses		28,780,638	2,915,827	32,814,374				32,814,374
70 VEHICLES (number)	**80**	191,882,721	19,779,149	**211,661,870**	**$ 2,645,773**		**2%**	**211,661,870**
70.01 Light Rail	80	172,568,577	17,815,117	190,383,694	$ 2,379,796			190,383,694
70.02 Heavy Rail		0	0	0				0
70.03 Commuter Rail		0	0	0				0
70.04 Bus		0	0	0				0
70.05 Other		390,200	10,419	400,619				400,619
70.06 Non-revenue vehicles		13,026,548	1,344,796	14,371,344				14,371,344
70.07 Spare parts		5,897,396	608,818	6,506,214				6,506,214
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)		1,514,775,728	144,939,061	**2,166,206,311**	**$ 107,804,980**	**42%**	**26%**	**2,178,152,556**
80.01 Preliminary Engineering		107,040,130	5,201,113	112,241,243				112,241,243
80.02 Final Design		441,749,718	52,351,911	501,312,550				512,666,204
80.03 Project Management for Design and Construction		544,663,797	33,983,529	799,920,682				799,920,682
80.04 Construction Administration & Management		167,963,353	12,642,151	297,695,183				298,287,774
80.05 Professional Liability and other Non-Construction Insurance		59,295,742	24,844,117	139,139,859				139,139,859
80.06 Legal; Permits; Review Fees by other agencies, cities, etc.		51,747,608	3,842,042	101,873,981				101,873,981
80.07 Surveys, Testing, Investigation, Inspection		77,710,753	5,807,902	143,151,889				143,151,889
80.08 Start up		64,604,627	6,266,297	70,870,924				70,870,924
Subtotal (10 - 80)		6,004,361,180	789,642,557	**7,761,985,327**	**$ 386,288,539**		**91%**	**7,891,413,327**
90 UNALLOCATED CONTINGENCY				**260,132,552**			**3%**	**273,640,866**
Subtotal (10 - 90)				**8,022,117,880**	**$ 399,234,482**		**95%**	**8,165,054,193**
100 FINANCE CHARGES*				**464,897,000**			**5%**	**464,897,000**
Total Project Cost (10 - 100)				**8,487,014,880**	**$ 422,370,880**		**100%**	**8,629,951,193**

*** Finance costs, including interest and bond issuance charges will be dependent on an extension of the General Excise and Use Tax Surcharge as well as the terms upon which the extension is based.**

Appendix B: Base Cost Estimate by Source of Funding

City and County of Honolulu
Honolulu Rail Transit Project
Plan A (East Kapolei to Ala Moana)

BCE by Source of Funding

STANDARD COST CATEGORY DESCRIPTION	YOE Dollars TOTAL	Federal 5309 New Starts	Federal Other (Section 5307)	Federal Other (ARRA)	Local
10 GUIDEWAY & TRACK ELEMENTS	$1,695,619,976	$304,545,287	$0	$0	$1,391,074,689
20 STATIONS, STOPS, TERMINALS, INTERMODAL	$916,959,112	$164,692,313	$0	$0	$752,266,799
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS	$120,015,787	$21,555,680	$0	$0	$98,460,107
40 SITEWORK & SPECIAL CONDITIONS	$2,181,062,067	$391,734,105	$0	$0	$1,789,327,962
50 SYSTEMS	$324,419,317	$58,267,994	$0	$0	$266,151,323
60 ROW, LAND, EXISTING IMPROVEMENTS	$263,522,643	$47,330,522	$0	$0	$216,192,121
70 VEHICLES	$211,661,870	$38,015,962	$0	$0	$173,645,908
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)	$2,178,152,556	$390,493,108	$0	$4,000,000	$1,783,659,448
90 UNALLOCATED CONTINGENCY	$273,640,866	$49,147,826	$0	$0	$224,493,040
100 FINANCE CHARGES	$464,897,000	$84,217,203	$0	$0	$380,679,797
Total Project Cost (10 - 100)	**$8,629,951,193**	**$1,550,000,000**	**$0**	**$4,000,000**	**$7,075,951,193**

Sources of Federal Funding and Matching Share Ratios	Costs Attributed to Source of Funds	All Federal Funds	Federal/ Local Matching Ratio within Source	Local Funds
Federal 5309 New Starts	$8,625,951,193	$1,550,000,000	23/77	$7,075,951,193
Federal Other (Section 5307)	$0	$0	N/A	$0
Federal Other (ARRA)	$4,000,000	$4,000,000	100/0	$0
Total	$8,629,951,193	$1,554,000,000		$7,075,951,193
Overall Federal Share of Project			18%	
New Starts Share of Project			18%	

Appendix G: Basis of Schedule

Honolulu Rail Transit Project
East Kapolei to Ala Moana Center
Basis of Schedule

April 2017

Table of Contents

Appendices

Acronyms and Abbreviations

AGS	Airport Guideway and Stations
BCS	Balanced Cantilevered Spans
BFS	City and County of Honolulu, Department of Budget and Fiscal Services
BOS	Basis of Schedule
CAM	Construction Access Milestone
CCGS	City Center Guideway and Stations
CEI	Construction Engineering and Inspection
CFCG	Configuration Control Group
CPM	Critical Path Methodology
CSC	Core Systems Contractor
DB	Design-Build
DBB	Design-Bid-Build
DBOM	Design-Build-Operate-Maintain
DFIM	Design-Furnish-Install-Maintain
DTU	Dillingham Temporary Utilities
E&E	Elevators and Escalators
EV	Earned Value
FEIS	Final Environmental Impact Statement
FHSG	Farrington Highway Station Group
FTA	Federal Transit Administration
GET	General Excise Tax
HART	Honolulu Authority for Rapid Transportation
HRTP	Honolulu Rail Transit Project
KHG	Kamehameha Highway Guideway
KHSG	Kamehameha Highway Station Group
kV	Kilovolt
LCC	Leeward Community College
MOT	Maintenance of Traffic
MPIS	Master Project Integrated Schedule
MPS	Master Project Schedule
MSF	Maintenance and Storage Facility
NTP	Notice to Proceed
PHGT	Pearl Highlands Garage and Transit Center
ROC	Rail Operations Center
ROW	Right-of-Way
SOM	Schedule of Milestones
SOV	Schedule of Values
SPI	Schedule Performance Index
SV	Schedule Variance
TPSS	Traction Power Substation
UHWO	University of Hawai'i–West O'ahu
WBS	Work Breakdown Structure
WOFH	West O'ahu/Farrington Highway Guideway
WOSG	West O'ahu Stations Group

1 Introduction

This Basis of Schedule (BOS) is intended to describe the methodology and assumptions used to develop and provide updates to the Master Project Integrated Schedule (MPIS). This document was previously updated on June 17, 2012, with a supplemental document provided in November 2015 (*Basis of Schedule Update*, dated November 5, 2015) which described changes in the anticipated contracting methodology and provided schedule details for the easternmost portion of the corridor.

The Honolulu Rail Transit Project (HRTP or the Project) consists of a 20.1-mile fixed rail system on elevated guideway structure from East Kapolei to Ala Moana Center, 20 elevated stations, 1 at-grade station, a Rail Operations Center (ROC, formerly known as the Maintenance and Storage Facility [MSF]) and service yard, parking facilities, intermodal facilities, utilities, roadway improvements, all system work, right-of-way (ROW) acquisition, relocations, 80 driverless rail vehicles, and complete professional services, including design, construction management, and owner costs.

The Project is approximately 38% complete, which includes completion of the ROC and 10.75 miles of elevated guideway constructed from the East Kapolei Station site to just past the Aloha Stadium Station site. It should be noted that the reported percentages complete are based on the current Estimate at Completion (EAC) and estimated Revenue Service Date (RSD) of December 2025.

With the recent award of the Airport Guideway and Stations (AGS) Design-Build contract, the Honolulu Authority for Rapid Transportation (HART) currently has over $4.27 billion either completed or under contract, which includes 15.9 of the 20.1 miles of guideway and 13 of the 21 stations. The two most significant contract packages yet to be awarded are the City Center Guideway and Stations (CCGS) Design-Build package, and the Pearl Highlands Garage and Transit Center (PHGT) Design-Build package; both are scheduled to be procured in 2018.

The upcoming contract packages will require a Baseline Schedule that will utilize the Critical Path Methodology (CPM) to depict the necessary detail of activities, durations, interim milestones, and logic necessary to achieve the contract-defined milestone requirements. In addition, interdependency logic ties by way of Contract Access Milestones (CAMs) will be included in order to define crucial access and cross-contract exchange of design, construction, and operational status information.

The MPIS shall be cost-loaded, to enable cost disbursement charts and trending histograms to be created from current actual costs. A Schedule of Milestones (SOM) will enable the MPIS to also be structured with earned value measurement gauges with assigned payment amounts upon accomplishment; Schedule Performance Index (SPI) indicators can then be charted and monitored at both the contract level and at the overall MPIS level. Each monthly update of the individual contracts' baseline CPM schedules will be summarized into the overall MPIS and will include CAM interfaces, coordination with third-party entities, and contract milestones. Each monthly update is reviewed and compared against the approved baseline, with any variances noted and reported with recommended corrective actions.

2 Project Goals

The Project has the following goals:

- Improve mobility within the corridor
- Improve travel reliability within the corridor
- Improve access to planned development in support of the City and County of Honolulu (City) policy to develop a Second Urban Center
- Improve transportation equity within the corridor

3 Project Calendars

The standard global Project calendar used for work days is 5 days per week, 8 hours per day, with 10 holidays, as indicated below.

The following ten holidays are incorporated as non-work periods in the global calendar.

Table 3-1 Global Project Calendar Holidays

Holiday	Time of Event
New Year's Day	1st work day in January
Martin Luther King, Jr., Day	2nd Monday in January
President's Day	3rd Monday in February
Memorial Day	Last Monday in May
King Kamehameha Day	11th day in June
Independence Day	4th day in July
Labor Day	1st Monday in September
Thanksgiving	4th Thursday in November
Day after Thanksgiving	4th Friday in November
Christmas	25th day in December

The global Project calendar to be used for contractor and subcontractor procurement activities for calendar days is 7 days per week, 8 hours per day (without holidays).

4 FTA Milestones

The following table details dates upon which the Project has achieved or is projected to achieve certain FTA milestones:

Table 4-1 Project FTA Milestones

Milestone	Date
Approval to Enter Preliminary Engineering	October 29, 2010 (Actual)
Final Environmental Impact Statement (FEIS) Record of Decision Issued	January 18, 2011 (Actual)
Approval to Enter Final Engineering	December 29, 2011 (Actual)
Full Funding Grant Agreement	December 19, 2012 (Actual)
FTA Recovery Plan A Submittal	April 30, 2017 (Actual)
Current FTA Revenue Service Date	January 31, 2020 (Projected)
Recovery Plan – Revenue Service Date	December 31, 2025 (Projected)

The following are awarded construction contracts with Substantial Completion dates:

Table 4-2 Awarded Construction Contract Substantial Completion Dates

Construction Contract	Substantial Completion Date
West O'ahu/Farrington Highway Guideway (WOFH) Design-Build (DB)	March 3, 2017*
Kamehameha Highway Guideway (KHG) DB	May 12, 2017
MSF DB	July 2, 2016 (actual)
West O'ahu Stations Group (WOSG) Design-Bid-Build (DBB)	March 12, 2018*
Farrington Highway Station Group (FHSG) DBB	December 17, 2017*
Kamehameha Highway Station Group (KHSG) DBB	May 17, 2019*
AGS DB	April 30, 2021
Core Systems Contractor (CSC) Design-Build-Operate-Maintain (DBOM)	March 15, 2019*
Fare Collection System Design-Furnish-Install-Maintain (DFIM)	January 15, 2029
Elevators and Escalators (E&E) DFIM	July 12, 2018*

*Change Orders are expected, or are in process, that may amend the Substantial Completion date.

During the last four years, and since the BOS Revision 3 was completed, there was a change in the expected contracting methodology and re-packaging of several construction contracts. This resulted in two large construction contract packages remaining to be awarded: the CCGS DB contract and the PHGT DB contract.

Passenger Service has been planned to support a uniform startup process and is broken into two passenger service opening dates:

- December 2020 for the nine west-side stations and guideway through Aloha Stadium Station, to be completed and opened as an Interim Opening Service date.
- December 2025 for the balance of the system including all 21 stations.

This BOS assumes the current General Excise Tax (GET) extension request will be approved by the State Legislature, Governor, and City Council, permitting the full build-out of the originally planned Minimum Operating Segment from East Kapolei to Ala Moana Center.

5 Schedule Control and Reporting

The original assumption of the June 2012 BOS was to have a Master Project Schedule (MPS) consisting of summarized dates from a series of project-wide network activities (ROW, Utilities by Utility Companies, Environmental Permits, etc., as well as unawarded construction or DB projects). These summarized dates and activities were to be updated on a monthly basis by HART personnel utilizing the final design and construction contract milestone dates. Over time, this translated into HART Project Controls staff updating the MPS schedules based on progress schedules from the construction contractors. The HART personnel, starting with the WOFH contract, were not able to receive timely progress schedules from the contractors, resulting in HART's inability to keep the MPS current.

This process was revised in February/March 2017. The Master Project Integrated Schedule (MPIS) is not a single schedule file; rather it is the product of a MPS and several contract schedule files utilizing external logic ties to integrate 15 schedules. The MPIS feeder schedules are Control Level Schedules (Level 3) with summary activities or Level of Effort activities (that reflect a group of activities from the contractors' schedule) and include the contract milestones for the contract. The P6 schedule files of the MPIS are listed below:

- Master Project Schedule – In general, this file contains activities that do not belong to any of the other contract files listed below, including Design contracts, Archeological Studies, lawsuit delays, utility work (not tracked in a contract file), funding delays, Interim Opening milestone, Revenue Service Date milestone, project contingency, contract project activities prior to the project baseline schedule (that is, PHGT), Consultant contracts, Level of Effort summary activities, etc.
- Right of Way (ROW) – Right of Way activities for the identified property needs for the project.
- West Oahu/Farrington Highway Guideway (WOFH)
- Kamehameha Highway Guideway (KHG)
- West Oahu Station Group (WOSG)
- Farrington Highway Station Group (FHSG)
- Kamehameha Highway Station Group (KHSG)
- Airport Guideway and Stations (AGS)
- City Center Guideway and Stations (CCGS)
- H2 Highway Off-ramp to Pearl Highlands Station (H2R2)

- Safety and Security
- Core Systems Contract – West
- Core Systems Contract – East
- University of Hawai'i–West Oahu (UHWO) Temporary Park-and-Ride
- Elevators and Escalators

The contractors' CPM monthly progress schedules will be used by the HART Project Controls staff to update monthly the Control Level Schedules that feed input to the MPIS. If contractors do not provide timely progress schedules (as was routine through 2016), the HART Project Controls staff will update the Control Level Schedule based on field staff daily reports, weekly reports, monthly reports, and discussions with the Construction Engineering and Inspection (CEI) field staff and/or CEI schedulers.

Included in the Contractor's Baseline CPM Schedule updates are the CAM dates that are used to monitor and control "cross-contract" interfaces. These CAM dates will be utilized in the Control Level Schedules to update contractor reported milestones and activities related to other contracts (using external logic ties) that may potentially affect progress not detailed in the contractor schedules, or include information of pending contract awards.

The primary guideline of the MPIS is that the information at a summary level contained within the MPIS is available and may be appropriate for public knowledge. The MPIS will be updated by the HART Project Controls team on a monthly basis.

The contractors' progress schedules are to be cost loaded according to the Schedule of Milestones (SOM) or Schedule of Values (SOV) as appropriate. With the SOM/SOV included in the Baseline Schedule, the detailed schedules will also provide a cash flow projection (Planned Value or Budgeted Cost of Work Scheduled) and actual scope accomplishment (Earned Value or Budgeted Cost of Work Performed), allowing for an evaluation of schedule performance.

6 Network of Schedules

6.1 Master Project Schedule

The Master Project Schedule (MPS) is a feeder schedule to the MPIS that includes the following:

- Environmental Actions
- Professional Services contracts (that is, Final Design, General Engineering Consultant, and CEI)
- Summary Levels of Effort for presentation purposes
- Procurement activities
- On-Call Contractor durations
- Airport Guideway and Stations construction planning activities, prior to accepted Contractor Baseline Schedule
- Agreements/Memoranda of Understanding
- Major milestone dates such as Interim Opening and Revenue Service Date

The purpose of the MPS has been to act as the backbone of the MPIS. The construction contracts and the Core Systems Contract started out as a set of summary activities embedded in the MPS. As the Project specifics were developed, the activities were expanded and eventually became a separate feeder schedule with external logic ties to the other schedule files of the MPIS. There are only two construction schedules remaining in the MPS at the time of this writing: AGS and PHGT. As the baseline schedule for AGS is submitted and eventually accepted by HART, the AGS activities in the MPS schedule will be deleted and replaced with a summarized schedule developed from the contractor's schedule, and external logic ties will be made in order to integrate it with the other related contracts. The same will occur upon award of the PHGT.

6.2 Guideway Segments

Each guideway section contains utility relocations, cast-in-place drilled shaft foundations, cast-in-place columns, pre-cast structural guideway bridge segments, trackwork, and roadway/site restoration work. The 20.1-mile corridor is broken down into the following segments:

- WOFH: 6.87 miles
- KHG: 3.88 miles
- AGS: 5.15 miles
- CCGS: 4.16 miles

Table 6-1 Guideway Segment Elements Breakdown

Segment	Foundation Shafts (Piers)	Columns	Pre-cast Segments	Aerial Stations	At-Grade Stations
West O'ahu/ Farrington Highway	309 completed	283 completed	3,209 – completed 84 – Balanced Cantilevered Spans (BCS) completed	5	1
Kamehameha Highway	186 completed	169 completed	2,029 – completed 43 – BCS completed	3	0
Airport	239	232	2,780	4	0
City Center	195	176	1,892 segments (172 spans)	8	0
Project Totals	**929**	**860**	**10,037**	**20**	**1**

Foundation shafts and columns that are not yet designed as part of a DB contract are based on typical 125-foot spacing. Pre-cast segments are based on normal 11-foot lengths. Some foundations have multiple piers (drilled shafts) supporting a single column, thus the difference in quantities.

Utility Relocations are performed by DB or DBB contractors, utility relocation contractors, and utility owners (based on Utility Agreements). In 2017 HECO informed HART that HECO will not perform utility relocation construction services for the electrical facilities within the Airport and City Center sections, including the Dillingham Temporary Utilities section. An on-call contractor is under solicitation for installation of the electrical distribution on the Airport and City Center segments of the alignment.

6.3 West-side Stations

The station groups on the WOFH and KHG segments, from East Kapolei to Aloha Stadium, are currently under construction as separate DBB contracts as indicated below. CAM dates are established within each of the three station contracts that correlate to milestone start activities in the CSC and E&E contracts.

The FHSG consists of West Loch Station, Waipahu Transit Center Station, and Leeward Community College (LCC) Station. LCC Station is the only at-grade station in the corridor, with the other facilities built alongside and over/under the WOFH guideway segment.

The WOSG consists of Ho'opili Station, University of Hawai'i–West O'ahu (UHWO) Station, and East Kapolei Station. All stations are built alongside and over/under the WOFH guideway segment.

The KHSG consists of Pearl Highlands Station, Pearlridge Station, and Aloha Stadium Station. Pearl Highlands Station is built alongside and over WOFH. Aloha Stadium Station and Pearlridge Station are built alongside and over/under the KHG segment.

6.4 East-side Guideway and Stations

The AGS DB contract is underway and consists of 171 spans of guideway and four stations, namely Pearl Harbor Naval Base Station, Honolulu International Airport Station, Lagoon Drive Station, and Middle Street Transit Center Station.

Dillingham Temporary Utilities (DTU) is an advanced utility relocation contract with the goal of temporarily relocating existing underground dry utilities (electrical, communications, telephone, cable, etc.) to newly installed utility poles along the Makai side of Dillingham Boulevard. It is anticipated that HART's On-Call Construction Contractor will be performing this work with the respective public utility companies.

The CCGS DB contract has yet to be awarded, and the scope of work involves 4.2 miles of elevated guideway and eight elevated stations. This contract is planned for award in May 2018 with Notice to Proceed (NTP) in August 2018. The CCGS guideway segment begins along Kamehameha Highway/Dillingham Boulevard, just east of the Middle Street Transit Center Station, and ends on Kona Street at Kona Iki Street, adjacent to Ala Moana Center. The eight stations within this segment consist of Kalihi Station, Kapālama Station, Iwilei Station, Chinatown Station, Downtown Station, Civic Center Station, Kaka'ako Station, and Ala Moana Center Station.

The details of the current contracting strategy for the CCGS schedule were initially developed in June 2015, with the Basis of Schedule contained in Appendix B of the "White Paper on Remaining Schedule and Expected Revenue Service Date" prepared by the HART Project Controls Division. In the months that followed, the schedule underwent an iterative process between HART Project Controls and the East CEI team. This process added more detailed activities/logic and considered topics such as productivity and work sequencing. Several meetings and discussions took place during this time.

With the AGS contract now awarded, the primary focus on the remaining CCGS segment is provided herein. The CGGS guideway segments are broken down into the following work areas for HART scheduling purposes only and are likely to be modified by the selected DB contractor in 2018.

- Area 1A: Track Stationing 1275 to Stationing 1295, (Span 636 to Span 655), which includes Kalihi Station.
- Area 1B: Track Stationing 1295 to Stationing 1333, (Span 656 to Span 680).
- Area 1C: Track Stationing 1333 to Stationing 1356, (Span 681 to Span 697), which includes Kapālama Station.
- Area 2: Track Stationing 1356 to Stationing 1374, (Span 698 to Span 711), which includes Iwilei Station.
- Area 3: Track Stationing 1374 to Stationing 1407, (Span 712 to Span 739), which includes Chinatown Station and Downtown Station.

- Area 4: Track Stationing 1407 to Stationing 1445, (Span 740 to Span 767), which includes Civic Center Station.

- Area 5: Track Stationing 1445 to Stationing 1471, (Span 768 to Span 788), which includes Kaka'ako Station.

- Area 6: Track Stationing 1471 to Stationing 1493, (Span 789 to Span 807), which includes Systems Site #23 and Ala Moana Center Station.

6.5 Rail Operations Center (ROC)

The ROC reached Substantial Completion on July 2, 2016. The CSC is now in control of the ROC facilities. Installation of facility equipment and rail yard track power and communications is ongoing.

6.6 Core Systems Contractor (CSC)

The CSC schedule is currently presented as two separate feeder schedules. The schedule portraying the western segment (Segment 1), leading to the Interim Opening at Aloha Stadium Station, summarizes the CSC schedule into a manner against which HART can properly track and forecast the impact of other contracts. The schedule portraying the eastern segment (Segment 2), leading to the Revenue Service Date, is more conceptual but still provides the necessary activities, durations, and milestones in order to portray the CSC time required to complete the systems work upon the completion of the construction. The CSC Segment 2 schedule will be expanded upon within the next year in order to provide a higher level of detail for tracking impacts to specific systems work leading to the RSD.

The CSC has partial/shared access to the guideway and stations during fixed facility construction to install cable and equipment until Substantial Completion of a fixed facility. CSC then has full access to complete systems installation and to perform integrated testing and pre-operations demonstrations that lead to the passenger opening. In general, each guideway and station contract has been scheduled such that the CSC will have a period of 4 to 6 months for installation prior to Substantial Completion of the fixed facility. The partial/shared access will require coordination and site control by the associated fixed facility contractor. Following Substantial Completion of the fixed facilities, the CSC has up to 9 months to complete installation, testing, and commissioning activities with full site control.

Remaining Access Criteria for CSC:

- Partial/shared access at-grade or on-deck of the guideway:
    - Guideway site remains under the control of the guideway contractor.
    - Specified civil interface points are complete and validated.

  - The Traction Power Substation (TPSS) sites have been prepared by the civil contractor and are free and clear and available for the installation of the TPSS equipment.
  - A reasonable section of at-grade system-wide duct bank is available to allow the commencement of CSC cable pulling activities.
  - On-deck access is available into the viaduct for installation of main cable ways.
  - On-deck access is available to a reasonable length of installed track to allow commencement of wayside equipment installation.

- Full access work-site control at-grade or on-deck of the guideway:
  - The site is handed over from the guideway contractor to the CSC.
  - All civil activities are complete to enable the electrical and mechanical systems to be powered and tested.
  - At-grade, all system-wide duct banks are installed.
  - On-deck, all track and third-rail equipment is fully installed.

- Shared access to equipment rooms in stations:
  - Equipment rooms within a station are complete including the first coat of paint.
  - The rooms and adjacent areas are clean and free of dust.
  - Doors are mounted and lockable.
  - Hanging ceilings and raised floors (if applicable) have not necessarily been installed, but all mounting positions are marked.
  - Temporary power and lighting is available.
  - All specified civil interface points are complete and validated.

- Balance of partial/shared access in stations:
  - Access is provided to passenger circulation and platform areas for installation of the balance of electrical and mechanical systems.
  - All areas are clean and free of dust or dust-producing activities.

- Hanging ceilings have not necessarily been installed, but mounting brackets or locations are marked.
- All specified civil interface points are complete and validated.
- For fare vending machine installation (by the separate Fare Collection System Contractor), passenger concourse areas must have final floor finishing complete.

- Full access work-site control in stations:
  - Work site control is handed over from the station contractor to the CSC.
  - With the exception of minor finishing activities, all civil and facility works are complete including station auxiliary equipment such as fire control and air conditioning, enabling all electrical and mechanical work to be completed and tested.
  - The station is clean and free of dust.
  - Subject to the CSC processes, the station is able to be powered and functionally tested.

Due to delays to the CSC contract, from the original contract award, the CSC is planning to incorporate a "pause" of the systems installation from April 2019 to October 2021 and a "pause" of all work not related to the operation and maintenance activities in the CSC contract from January 2020 to October 2021. With this scenario, the CSC will have approximately three years to complete systems installation and testing prior to the full RSD.

6.7 Other Project-wide Contracts

The E&E Contract has been established wherein each station will be designed to standard dimensions and envelopes so that the E&E Contractor can furnish, install, test, and maintain the elevators and escalators in concert with the CSC and fixed facility operations. The E&E Contractor will work closely with each station designer and contractor to interface and integrate associated supporting systems installation.

7 Contract Status

The status of each HRTP contract and its impact on the Interim Opening Date and the Revenue Service Date is shown below.

Table 7-1 Contract Status and Impact

Contract	Impacts	Status
WOFH	Interim Opening	Nearing Substantial Completion
KHG	Interim Opening	Nearing Substantial Completion
WOSG	Interim Opening	Early Construction – Not Critical Path
FHSG	Interim Opening	Early Construction – Not Critical Path
KHSG	Interim Opening	Early Construction – **Critical Path to Interim Opening**
MSF	Interim Opening	Substantially Complete
AGS	Revenue Service	Early Design – Not Critical Path
DTU	Revenue Service	Design planned completion in April 2017
CCGS	Revenue Service	Planned solicitation for NTP on August 31, 2018 – **Critical Path**
CSC	Both	**Critical Path** upon KHSG completion for Interim Opening **Critical Path** upon CCGS completion for Revenue Service

8 Production Rate Assumptions

Table 8-1 Production Rate Assumptions

Type of Work	Production Rate (per crew)
Foundations (drilled shafts 7 to 8 feet in diameter)	6 days per shaft (drilling, cleaning, inspection, install rebar cage, monitoring ducts, place concrete, and complete transition zone) except for Area 3 (10 days per shaft)
Columns (20 to 50 feet in length)	6 days per column (install rebar, install formwork, place concrete, and remove formwork for standard piers and L-type piers)
Precast Segment Structure (each truss for supporting 11 segments per span)	4.6 days per span (launch, initial set, epoxy, align, post-tension, and grout)
Utilities Relocation	
Water Line (Trenching and Installation)	9 to 16 linear feet per day
Sewer Line (Trenching and Installation)	8 to 13 linear feet per day
Duct Bank, 18 inches wide x 4 feet deep	14 linear feet per day
Duct Bank, 24 inches wide x 5 feet deep	10 linear feet per day
Duct Bank, 36 inches wide x 5 feet deep	4 to 9 linear feet per day

9 Schedule Contingency

Given the critical path described below, the current schedule contains 355 days of contingency, leading to a Revenue Service Date of December 31, 2025. Contingency is tracked as a separate activity at the end of the Project.

10 Assumptions (CCGS)

The following assumptions have been considered regarding CCGS:

- The CSC will incorporate a "pause" of the systems installation from April 25, 2019, to October 8, 2021, and a "pause" of all work not related to the operation and maintenance activities in the CSC contract from January 20, 2020, to October 9, 2021.
- NTP provided to CCGS Contractor by or on August 31, 2018.
- ROW acquisition by HART is assumed to be completed before August 31, 2018.
- The MPIS assumes the HART On-Call Contractor will complete the DTU Contract relocations prior to the CCGS Contactor widening Dillingham Boulevard.
- The CCGS schedule assumes wet utility relocation work will be concurrent with the interim road widening activities.
- The 138 kilovolt (kV) work on Dillingham Boulevard can be performed concurrently with dry utility work, but must be completed prior to the drill shaft operation beginning in the area. The schedule assumes the 138 kV line must be energized prior to segment erection in Areas 1A, 1B, and 1C.
- It is assumed the interim road widening activity must be complete prior to commencing permanent dry utility relocation work in each given Work Area.
- AECOM is preparing final design drawings for the utility relocation and roadway realignment along the entire guideway alignment. The "Signed and Sealed" and utility coordinated drawings provided at the end of the AECOM design contract will be provided to the CCGS bidders as they become available.
    - The intention is for HART to provide Signed and Sealed Drawings for utility relocation and roadworks construction, making the utility relocation a DBB component to the full CCGS DB contract.
    - It is assumed and anticipated that providing utility designs to the selected DB contractor will avoid the large delays experienced on the west-side contracts, due to third-party coordination and review occurring prior to the DB construction contract.
- The Utility Relocations sequencing generally starts with relocating wet utilities, then removal of pre-existing lines with a concurrent effort to relocate dry utilities, followed by guideway drainage and site drainage.

- It is assumed that the relocation of utilities (especially trenching, laying, and backfill of underground power and telecommunication lines) in the median does not overlap with the commencement of drilled shaft construction, except for approximately 100 days in Area 1B.

- The maximum number of crews working in each area is tabulated below. Areas 1B and 6 are on the Critical Path.

Table 10-1 CCGS Work Crew Breakdown

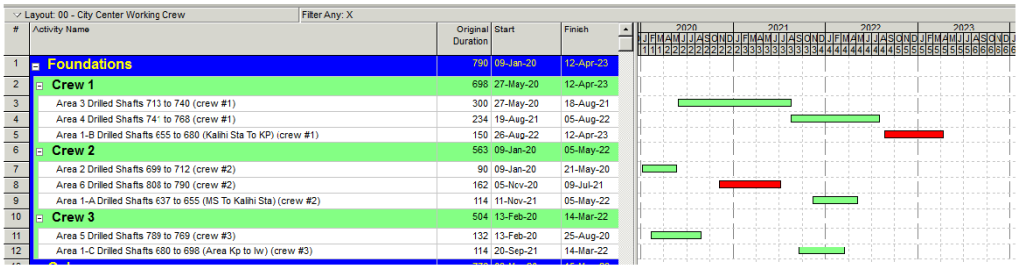
Work Area	Length (Feet)	Maximum Number of Crews	Total Float (months)
Area 1A	2,100	3	2
Area 1B	3,700	5	0
Area 1C	2,400	4	2
Area 2	1,700	3	3
Area 3	3,400	3	0.7
Area 4	3,600	4	4
Area 5	2,700	3	1.5
Area 6	2,300	5	0

- The drilled shaft productivity rate used is 6 days per drilled shaft (drilling, installing rebar cage, placing concrete, and complete transition zone). Typical dimensions are 7 to 8 feet in diameter, and depths range from 40 to 150 feet. A particular area in Area 3, over Nuuanu Stream in the Chinatown area, has a lower productivity of 10 days per drilled shaft to accommodate for the deeper shafts and the difficulty of wet drilling in and near the stream. The productivity is based on historical data from the KHG and WOFH Contracts as well as data drawn from AGS proposals.

- The cast-in-place column/pier productivity rate used is 6 days per column. This is also consistent with the durations on WOFH and KHG, adjusting for specific columns where issues were experienced.

- Three sets of drilled shaft/piling rigs (three work crews) are used to construct the drilled shafts. The sequence of each crew is shown below:

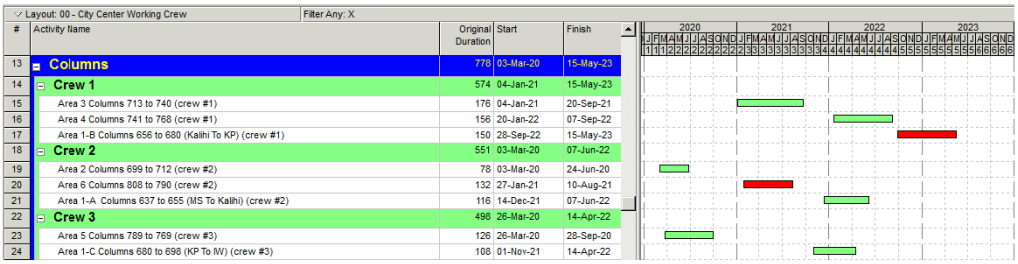
Figure 10-1 CCGS Drilled Shaft/Piling Rig Sequence of Work



#	Activity Name	Original Duration	Start	Finish
1	Foundations	790	09-Jan-20	12-Apr-23
2	Crew 1	698	27-May-20	12-Apr-23
3	Area 3 Drilled Shafts 713 to 740 (crew #1)	300	27-May-20	18-Aug-21
4	Area 4 Drilled Shafts 74' to 768 (crew #1)	234	19-Aug-21	05-Aug-22
5	Area 1-B Drilled Shafts 655 to 680 (Kalihi Sta To KP) (crew #1)	150	26-Aug-22	12-Apr-23
6	Crew 2	563	09-Jan-20	05-May-22
7	Area 2 Drilled Shafts 699 to 712 (crew #2)	90	09-Jan-20	21-May-20
8	Area 6 Drilled Shafts 808 to 790 (crew #2)	162	05-Nov-20	09-Jul-21
9	Area 1-A Drilled Shafts 637 to 655 (MS To Kalihi Sta) (crew #2)	114	11-Nov-21	05-May-22
10	Crew 3	504	13-Feb-20	14-Mar-22
11	Area 5 Drilled Shafts 789 to 769 (crew #3)	132	13-Feb-20	25-Aug-20
12	Area 1-C Drilled Shafts 680 to 698 (Area Kp to Iw) (crew #3)	114	20-Sep-21	14-Mar-22

- Three sets of formworks (three work crews) are used to construct the columns/piers. The sequence of each crew is shown below:

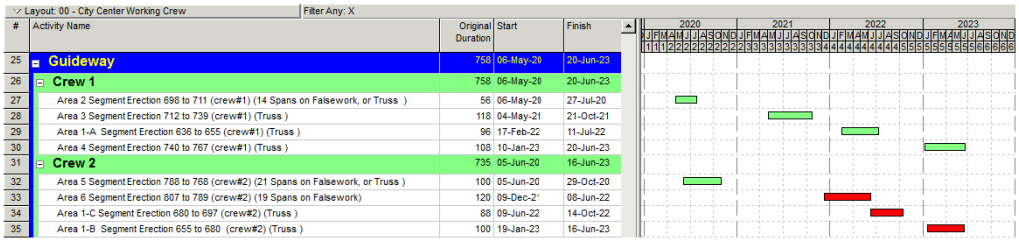
Figure 10-2 CCGS Formwork Sequence of Work



#	Activity Name	Original Duration	Start	Finish
13	Columns	778	03-Mar-20	15-May-23
14	Crew 1	574	04-Jan-21	15-May-23
15	Area 3 Columns 713 to 740 (crew #1)	176	04-Jan-21	20-Sep-21
16	Area 4 Columns 741 to 768 (crew #1)	156	20-Jan-22	07-Sep-22
17	Area 1-B Columns 656 to 680 (Kalihi To KP) (crew #1)	150	28-Sep-22	15-May-23
18	Crew 2	551	03-Mar-20	07-Jun-22
19	Area 2 Columns 699 to 712 (crew #2)	78	03-Mar-20	24-Jun-20
20	Area 6 Columns 808 to 790 (crew #2)	132	27-Jan-21	10-Aug-21
21	Area 1-A Columns 637 to 655 (MS To Kalihi) (crew #2)	116	14-Dec-21	07-Jun-22
22	Crew 3	498	26-Mar-20	14-Apr-22
23	Area 5 Columns 789 to 769 (crew #3)	126	26-Mar-20	28-Sep-20
24	Area 1-C Columns 680 to 698 (KP To IW) (crew #3)	108	01-Nov-21	14-Apr-22

- Two sets of guideway segment erection trusses (two work crews) are used to construct the guideway bridge segments. The sequence of each crew is shown below:

Figure 10-3 CCGS Guideway Segment Erection Truss Sequence of Work



#	Activity Name	Original Duration	Start	Finish
25	Guideway	758	06-May-20	20-Jun-23
26	Crew 1	758	06-May-20	20-Jun-23
27	Area 2 Segment Erection 698 to 711 (crew#1) (14 Spans on Falsework, or Truss)	56	06-May-20	27-Jul-20
28	Area 3 Segment Erection 712 to 739 (crew#1) (Truss)	118	04-May-21	21-Oct-21
29	Area 1-A Segment Erection 636 to 655 (crew#1) (Truss)	96	17-Feb-22	11-Jul-22
30	Area 4 Segment Erection 740 to 767 (crew#1) (Truss)	108	10-Jan-23	20-Jun-23
31	Crew 2	735	05-Jun-20	16-Jun-23
32	Area 5 Segment Erection 788 to 768 (crew#2) (21 Spans on Falsework, or Truss)	100	05-Jun-20	29-Oct-20
33	Area 6 Segment Erection 807 to 789 (crew#2) (19 Spans on Falsework)	120	09-Dec-2	08-Jun-22
34	Area 1-C Segment Erection 680 to 697 (crew#2) (Truss)	88	09-Jun-22	14-Oct-22
35	Area 1-B Segment Erection 655 to 680 (crew#2) (Truss)	100	19-Jan-23	16-Jun-23

11 Critical Path

The MPIS is being managed using the CPM, which is managing the longest sequence of activities that must be completed on time for the Project to complete on or by the due date. It identifies critical (versus non-critical) activities that, if one is delayed for a day, the entire Project will be delayed for a day unless a successor Critical Path activity is completed a day earlier. The Critical Path may potentially change each month the MPIS is updated. At the time of this writing, the Critical Path shows the following:

- The DTU Contract removes all of the underground dry utilities from beneath the existing roadway and has the utility companies installing their respective utility lines on temporary joint-use poles. The HART On-Call Contractor will provide assistance to pole installation by removing trees, repairing sidewalks, and providing other support types of construction work.

- Utility relocation is a significant part of the CCGS DB project. The first action envisioned for the CCGS Contractor is to temporarily widen Dillingham Boulevard in order to provide sufficient room for Maintenance of Traffic (MOT). Wet and dry utility relocation work will occur immediately following roadway widening. Installation of dry utility infrastructure, such as duct banks, manholes, handholes, etc., that support the various utilities (Oceanic-Time Warner, Hawaiian Electric Company, Hawaiian Telcom, AT&T), is planned to be completed prior to the utility companies installing conductors and prior to removal from the joint-use poles installed during the DTU project.

- The CCGS station driving the Critical Path depends upon the sequencing of the guideway construction, which is ultimately decided by the selected CCGS Contractor. The last station to provide partial access to the guideway to CSC will fall on the Critical Path toward the end of the CCGS construction contract.

- The completion of Core Systems installation, final testing, and performance of the demonstration test is tied to station Substantial Completion. This logic provides the CSC 12 months to complete its work, test, certify, and start Revenue Service. There is also 355 days of float (contingency) included leading to Revenue Service on December 31, 2025.

The duration of the CCGS DB Contract is planned to be 65 months. The CCGS Critical Path (longest path) is found to run through two distinct, yet concurrent logic paths.

11.1 Longest Path 1

After NTP and mobilization, the Critical Path runs through Area 1B, interim road widening, utility relocation (trenching, laying of telecommunication lines, and backfilling), drilled shaft construction, column construction, and segment erection, ending with trackwork installations (Area 1B to Area 1C), which leads to CCGS Substantial Completion on January 12, 2024.

11.2 Longest Path 2

After NTP and mobilization, the near Critical Path runs through Area 6 utility relocation, drilled shaft construction, column and straddle bent construction, and segment erection from Area 6 to Area 1C, which continues to Kapālama station construction, which ends in CCGS Substantial Completion on January 12, 2024.

12 Price Allocation

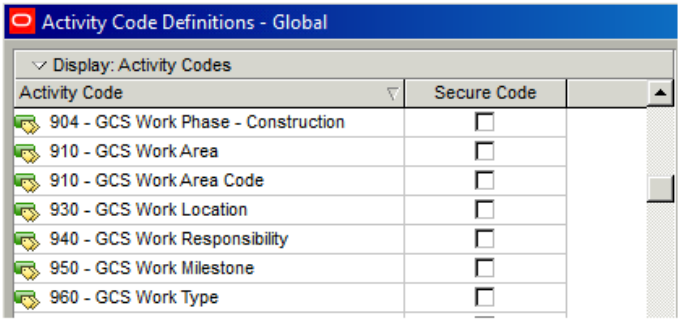
Each contract baseline schedule will be cost loaded and contain cost (price) allocation to activities and/or milestones according to bid/proposal items. These allocations come from the SOM/SOV Pay Items and provide a cash flow based on scope accomplishment and the payment disbursement planned and actual as the contract progresses. The monthly plan versus actual accomplishment will provide a progress indicator that tracks and reports Earned Value (EV), SPI, as well as the Schedule Variance (SV) and financial percent complete.

13 Activity Coding

Based on the HART-furnished Work Breakdown Structure (WBS), the coding system will enable common framework for contracts to be summarized to the MPIS level.

The Global Activity Codes used are as follow:

Figure 13-1 Global Activity Codes



There are three types of milestones used on the contract and MPIS schedules: Pay Milestones, Interface/Coordination Milestones, and Contract Access Milestones. These have unique codes that enable filtering and reporting as well as summarizing to the MPIS level from the contract level. Refer to Appendix A for the WBS established for the HRTP.

14 Constraints and Interfaces

Minimum constraints are used in the MPIS to enable the longest path or Critical Path to be tracked. Constraints are classified as hard constraints or soft constraints. Any constraints other than the start, Interim Opening, and RSD will contain a justification for use.

14.1 Constraints

Each contract contains a list of HART-furnished dates for facility access, environmental permits, materials, and interface milestones (work by others). In addition, a contract may have other site constraints that would be identified with dates (ROW/easements and/or utility relocations by others) or work conditions (for example, the corridor's MOT requirements). It is expected that each contract will contain logic, milestones, and activities that reflect these constraints and interfaces and will be summarized with plans, updates, and progress to the MPIS on a monthly basis. Any interface or impact to other contracts identified at the contract level will be immediately reported through the HART Project Controls Manager to the Configuration Control Group (CFCG) for disposition. The impacting contract status will provide corrective action and/or recommendations for the CFCG to consider.

Core Systems installation access is planned to occur at each station's equipment room approximately 4 months prior to that station's Substantial Completion. Guideway access is first at grade on the completed System Site slabs and duct banks and on deck approximately 6 months prior to Guideway Substantial Completion. At Substantial Completion, full access (and site control) is transferred over to the CSC to complete installation and make ready for Integrated Testing and Demonstration prior to passenger service. This requires that each operating section be Substantially Complete at least 9 months prior to passenger service (Guideway, Stations, and ROC).

14.2 Interface Table

An Interface Table has been generated which lists milestones that are provided ("pitched") by the contractor to others and those received ("caught") by the contractor from others to perform its work. The Interface Manager has the responsibility to conduct meetings to address these interactions of the contractors and maintain/circulate the Interface Table and accompanying status documentation. The contractor-assigned coordinators must participate in these meetings and may identify other key interfaces that could affect schedule performance, which will be monitored by the Interface Manager. Should a contract interface impact progress or productivity or threaten the attainment of key MPIS milestones, the interface is reported with recommended actions to the CFCG.

Please see Appendix B for the Interface Table with CAM dates.

15 Measurement of Scope Accomplishment

The following are typical metrics used to measure progress of scope items:

- Number of design deliverables submitted or approved
- Schedule of Value or Schedule of Milestone items completed
- Linear feet of utilities relocated or installed
- Linear feet of roadworks completed
- Number of drilled shafts/foundations completed
- Number of columns completed
- Number of precast segments casted
- Number of precast segments erected, post-tensioned, and grouted
- Quantity of earthworks excavated or backfilled
- Square feet of slab erected

16 Schedule of Milestones and Schedule of Values

The SOM consists of a number of Pay Items that detail the contract's Schedule of Prices (Price Items) into manageable and verifiable scope items. For example, a Guideway contractor may break their foundations into work areas, and each associated foundation has a SOM Pay Item. When that Pay Item is accomplished and verified by HART staff, payment is made on the agreed-upon portion of the firm price assigned to that item. Pay Items must summarize to and cannot exceed the contract's Price Item and their contract value (lump sum). With payment on completed (accomplished) scope items, the contractors have the freedom to identify discrete elements for payment as long as their accomplishment can be verified by HART. Another example may be the Quality Management Plan (QMP) being broken down into (1) QMP outline, (2) QMP draft, and (3) QMP final, where each has an allocated payment value when submitted.

The SOV is a list furnished by contractors outlining the breakdown of the contract sum by schedule activity. It allocates values for the various parts of the work and is also used as the basis for submitting and reviewing Pay Requests. The SOV is intended to provide linkage between the contractor's baseline schedule and the planned payment request details. Once approved by HART, the SOV serves as the basis for contractor pay requests/invoices, subject to review and confirmation that the amount of work associated with the requested Pay Item values has been satisfactorily performed.

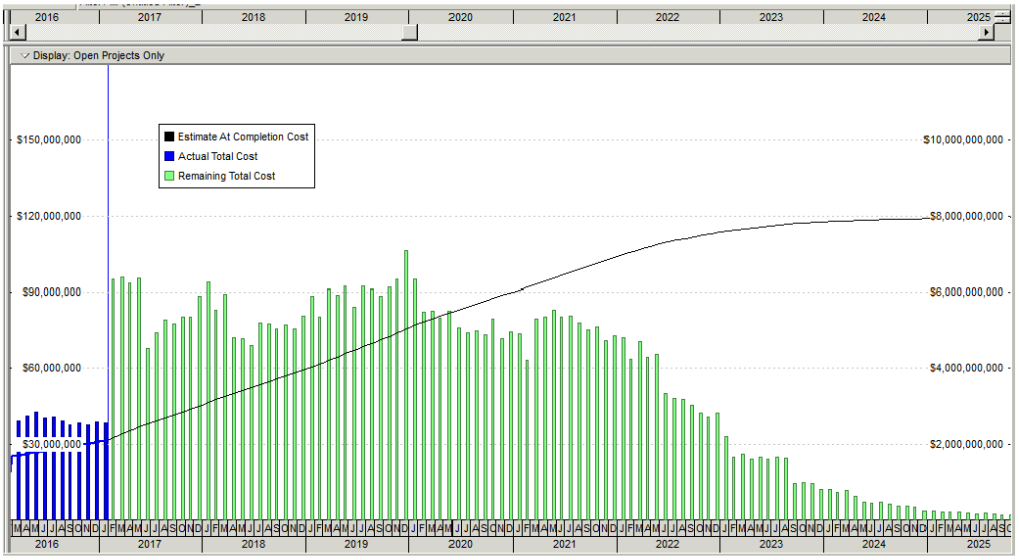
17 Cash Flow Forecast

The revised cost-loaded MPIS Baseline uses a data date of January 31, 2017, which is a re-baseline of the previous MPIS. The target completion date is December 31, 2025, which is the projected Revenue Service Date. The EAC Cost Curve and Remaining Early Cost Histograms will be plotted and used as a baseline for comparison against monthly achievement (Earned Value). The Cash Flow Forecast will be reported in the HART Monthly Progress Report.

For each contract package, the EAC cost curve and Remaining Early Cost Histograms (as of January 31, 2017) will be used to measure the monthly progress.

An example EAC cost curve and Remaining Early Cost Histogram is shown below:

Figure 17-1 EAC Cost Curve and Remaining Early Cost Histogram Example



18 Monthly Pay Request

Each month, contractors submit a Pay Request based on the last Friday of the month, which includes the following: the updated SOV or SOM with items accomplished during that period, planned for next period, and supported by the progressed schedule update; and identification of variances or changes to planned (if any). The HART staff reviews and confirms the contractors' Pay Requests, by verifying the reported monthly accomplishments based on field daily reports, weekly reports, monthly progress reports, the Primavera P6 progress schedule, and progress measurements recorded by the CEI team, and recommends payment by the City Department of Budget and Fiscal Services (BFS). Contract schedules are updated and summarized to the MPIS as well as variances analyzed with corrective actions. Any variances that impact the MPIS or the Project Budget are immediately identified with recommended corrective actions.

19 Professional Services Availability

This BOS assumes that the required professional services are adequately available for existing design and project management activities, upcoming DB contracts, and other such services.

20 Construction Labor, Material, and Equipment Availability

This BOS assumes that an adequate pool of construction labor, material, and equipment is readily available in the Hawai'i marketplace to effectively support the requirements of the upcoming large DB contracts without competing or placing stress on other ongoing work.

21 ROW Acquisition, Easements, and Permits

The HRTP has identified parcels that require acquisition and/or easements to deliver the MPIS as developed for this update. The HART ROW team has developed a detailed sub-schedule that is part of the MPIS's feeder schedules. Environmental permits are provided by HART to contractors, while the contractors are tasked with securing construction permits. Environmental compliance is monitored by HART.

Appendix A Work Breakdown Structure (Levels 1-3)

Exhibit A-1 Work Breakdown Structure, Level 1

Level 1 Code	Segment	WBS Level
A	Project Wide	WBS Level 1
B	West Oahu/Farrington	WBS Level 1
C	Maintenance Storage Facility	WBS Level 1
D	Kamehameha	WBS Level 1
E	West	WBS Level 1
F	Airport	WBS Level 1
G	City Center	WBS Level 1
L	East	WBS Level 1

Exhibit A-2 Work Breakdown Structure, Level 2

Level 2 Code	Location	WBS Level
B	Other	WBS Level 2
G	Guideway	WBS Level 2
P	Project Wide	WBS Level 2
S	Station	WBS Level 2

Exhibit A-3 Work Breakdown Structure, Level 3

Level 3 Code	Specific Location	WBS Level
00	Project Wide	WBS Level 3
50	HDOT Signals	WBS Level 3
70	OMPO Transit Fares	WBS Level 3
80	EPA	WBS Level 3
M0	CSC - All	WBS Level 3
M1	CSC - Opening 1	WBS Level 3
M2	CSC - Opening 2	WBS Level 3
M3	CSC - Opening 3	WBS Level 3
VG	CSC - Vehicles	WBS Level 3
R01	Core Systems Milestones	WBS Level 3
R02	Core Systems Hold Points	WBS Level 3
R03	Core Systems Manual Train Testing	WBS Level 3
R04	Core Systems Functional Train Testing	WBS Level 3
R05	Core Systems Activation	WBS Level 3
11	Park & Ride Areas	WBS Level 3
01	WOFH - Span 393 to 592	WBS Level 3
02	WOFH - Span 529 to 698	WBS Level 3
03	WOFH - Span 628 to 680	WBS Level 3
04	WOFH - Span 680 to 700	WBS Level 3

Level 3 Code	Specific Location	WBS Level
05	WOFH - Span 700 to 730	WBS Level 3
06	WOFH - Span7 30 to 745	WBS Level 3
07	WOFH - Span 745 to 755	WBS Level 3
BB	West Oahu Stations	WBS Level 3
B1	East Kapolei Station	WBS Level 3
B2	UH West Oahu Station	WBS Level 3
B3	Ho'opili Station	WBS Level 3
CC	All FHSG Stations	WBS Level 3
C1	West Loch Station	WBS Level 3
C2	Waipahu Station	WBS Level 3
C3	Leeward Community College Station	WBS Level 3
01	MSF - Maintenance Support Fac.	WBS Level 3
03	MSF - Yard and Track	WBS Level 3
04	MSF - MOW	WBS Level 3
05	MSF - Train Wash Facility	WBS Level 3
06	MSF - Wheel Truing Facility	WBS Level 3
07	MSF - Track Procurement	WBS Level 3
08	MSF - OSB	WBS Level 3
09	PHPS Pearl Highlands Parking Structure	WBS Level 3
10	H2R2 - Pearl Highlands H2 Ramps	WBS Level 3
21	KHG - Sta 755 - 886	WBS Level 3
22	KHG - Sta 886 - 961	WBS Level 3
31	KHG - Sta 961 - 975	WBS Level 3
C4	Pearl Highlands Station	WBS Level 3
D1	Pearl Ridge Station	WBS Level 3
J1	Aloha Stadium Station	WBS Level 3
EE	West Stations	WBS Level 3
32	A7 - Pearl Harbor to Airport Segment	WBS Level 3
33	A7 - Airport to Lagoon Drive	WBS Level 3
AP	ASU - Pre Pre-Construction	WBS Level 3
BN	ASU - Nimitz Highway	WBS Level 3
CK	ASU - Kamehameha Highway	WBS Level 3
DD	ASU - Airport Area	WBS Level 3
EA	ASU - Aolele	WBS Level 3
FP	ASU - Lagoon Park	WBS Level 3
GN	ASU - Nimitz East End	WBS Level 3
HO	ASU - Other Dillingham	WBS Level 3
KO	ASU - Post Construction	WBS Level 3
PP	A7 - Project Wide	WBS Level 3
P1	A7 - Pier 552R	WBS Level 3
P2	A7 - Pier 551R	WBS Level 3
P3	A7 - Pier 550	WBS Level 3
P4	A7 - Pier 549	WBS Level 3
P5	A7 - Pier 546	WBS Level 3
P6	A7 - Pier 548	WBS Level 3
34	AGS RA - Span 425 to Span 473	WBS Level 3
35	AGS RB - Span 474 to Span 510	WBS Level 3
36	AGS RC - Span 511 to Span 583	WBS Level 3
37	AGS RD - Span 784 to Span 597	WBS Level 3

Level 3 Code	Specific Location	WBS Level
38	AGS RE - Span 597 to Span 636	WBS Level 3
JJ	Airport Stations	WBS Level 3
J3	Pearl Harbor Station	WBS Level 3
J4	Airport Station	WBS Level 3
J5	Lagoon Drive Station	WBS Level 3
E3	Middle Street Transit Center Sta.	WBS Level 3
41	CCGS - Area 1A - Span 636 to Span 655	WBS Level 3
42	CCGS - Area 1B - Span 656 to Span 680	WBS Level 3
43	CCGS - Area 1C - Span 681 to Span 697	WBS Level 3
44	CCGS - Area 2 - Span 698 to Span 711	WBS Level 3
45	CCGS - Area 3 - Span 712 to Span 739	WBS Level 3
46	CCGS - Area 4 - Span 740 to Span 767	WBS Level 3
47	CCGS - Area 5 - Span 768 to Span 788	WBS Level 3
48	CCGS - Area 6 - Span 789 to Span 807	WBS Level 3
E4	Kalihi Station	WBS Level 3
E5	Kapalama Station	WBS Level 3
G1	Iwilei Station	WBS Level 3
G2	Chinatown Station	WBS Level 3
G3	Downtown Station	WBS Level 3
G4	Civic Center Station	WBS Level 3
G5	Kaka'ako Station	WBS Level 3
G6	Ala Moana Station	WBS Level 3
GG	Kaka'ako Stations	WBS Level 3
LL	East Stations	WBS Level 3

Appendix B Interface Table with Contract Access Milestone Dates

Activity ID	Activity Name	Early Start	Early Finish
CCGS	Core Systems Stations Install		
ST15KP1480	CSC Access at AUX Equip Bldg/TCCR-3A at KLM		5-Jun-20
ST16IW1480	CSC Access at AUX Equip Bldg/TCCR-8A at IWL		22-Jun-20
ST16IW1740	CSC Partial Access Balance of Station Structure-8B at IWL		3-Nov-20
ST17CH1480	CSC Access at AUX Equip Bldg/TCCR-3A at CTN		3-Mar-21
ST19CV1480	CSC Access at AUX Equip Bldg/TCCR-3A at CVC		26-Mar-21
ST21AM1480	CSC Access at AUX Equip Bldg/TCCR-6A at ALM		7-Apr-21
ST16IW1840	CSC Partial Platform Access for CSC Install-8E at IWL		19-Apr-21
ST20KK1480	CSC Access at AUX Equip Bldg/TCCR-8A at KAK		9-Jun-21
ST20KK1840	CSC Partial Platform Access for CSC Install-8E at Kaka'ako		26-Aug-21
ST20KK1740	CSC Partial Access Balance of Station Structure-8B at Kaka'ako		5-Oct-21
ST18DW1480	CSC Access at AUX Equip Bldg/TCCR-3A at DNT		8-Oct-21
ST16IW1950	Iwilei Station - CSC FULL ACCESS IN STA-8H		12-Oct-21
ST14KL1480	CSC Access at AUX Equip Bldg/TCCR-3A at KLH		27-Oct-21
ST17CH1740	CSC Partial Access Balance of Station Structure-3B at CTN		21-Dec-21
ST19CV1740	CSC Partial Access Balance of Station Structure-3B at CVC		23-Dec-21
ST18DW1740	CSC Partial Access Balance of Station Structure-3B at DNT		19-Jan-22
ST17CH1840	CSC Partial Platform Access for CSC Install-3E at CTN		25-Apr-22
ST18DW1840	CSC Partial Platform Access for CSC Install-3E at DNT		25-Apr-22
ST18DW1950	Downtown Station - CSC Full Access in Sta-3H		24-May-22
ST17CH1950	Chinatown Station - CSC FULL ACCESS IN STA-3H		24-May-22
ST20KK1950	Kaka'ako Station - CSC Full Access in Sta-8H		11-Oct-22
ST21AM1740	CSC Partial Access Balance of Station Structure-6B at ALM		5-Dec-22
ST14KL1740	CSC Partial Access Balance of Station Structure-3B at KLH		6-Jan-23
ST14KL1840	CSC Partial Platform Access for CSC Install-3E at KLH		6-Mar-23
ST21AM1840	CSC Partial Platform Access for CSC Install-6E at ALM		20-Apr-23
ST14KL1950	Kalihi Station - CSC FULL ACCESS IN STA-3H)		8-May-23
ST15KP1840	CSC Partial Platform Access for CSC Install-3E at KLM		14-Aug-23
ST15KP1740	CSC Partial Access Balance of Station Structure-3B at KLM		28-Aug-23
ST19CV1950	Civic Center Station- CSC Full Access in Sta-3H		18-Sep-23
ST19CV1840	CSC Partial Platform Access for CSC Install-3E at CVC		18-Sep-23
ST21AM1950	Ala Moana - CSC Full Access in Sta-6H		29-Nov-23
ST15KP1950	Kapalama Station - CSC FULL ACCESS IN STA-3H		12-Jan-24
	City Center Guideway and Dillingham Kakaako Stations		
ST17CHEE10	E&E Contractor Partial Access to Install Elev/Escalators	17-May-21	
ST16IW1EE10	E&E Contractor Partial Access to Install Elev/Escalators	19-Jul-21	
ST20KKEE10	E&E Contractor Partial Access to Install Elev/Escalators	7-Sep-21	
ST19CVEE10	E&E Contractor Partial Access to Install Elev/Escalators	2-Nov-21	
ST18DWEE10	E&E Contractor Partial Access to Install Elev/Escalators	23-Nov-21	
ST14KLEE10	E&E Contractor Partial Access to Install Elev/Escalators	18-Apr-22	
ST21AMEE10	E&E Contractor Partial Access to Install Elev/Escalators	6-Dec-22	
ST15KPEE10	E&E Contractor Partial Access to Install Elev/Escalators	18-May-23	
EGRW1110	Right of Way to Properties Obtained (sta. 1275 to sta. 1295) Contractor Access		29-Dec-17

Activity ID	Activity Name	Early Start	Early Finish
EGRW1210	Right of Way to Properties Obtained (sta. 1295 to sta. 1333) Contractor Access		29-Dec-17
EGRW1310	Right of Way to Properties Obtained (sta. 1334 to sta. 1356) Contractor Access		29-Dec-17
EGRE5010	Right of Entry to Properties Obtained (sta. 1448 to sta. 1459) Contractor Access		29-Dec-17
EGRE6020	Right of Entry to Properties Obtained (sta. 1472 to sta. 1479) Contractor Access		29-Dec-17
HART - FHSG			
	West Oahu/Farrington Highway Segment		
WTC-1315	Waipahu Platform Site Access Received	3-Mar-17	
WTC-03	Platform Construction, Partial Access for FHSG to Construct Platform	3-Mar-17	
LCC-2270	LCC HDCC Platform Access Turnover	10-Mar-17	
LCC-03	Platform Construction, Partial Access for FHSG to Construct Platform	16-Mar-17	
LCC-1500	Leeward CC Station General Site Access	16-Mar-17	
LCC-2165	Platform Access Received	16-Mar-17	
LCC-2265	Access to Tunnel - LCC Ped Tunnel	1-May-17	
WLO-01	Auxiliary Equipment Building/TCCR, Partial Access for Systems Installation	19-Sep-17	
WLO-04	Elevator & Escalators Installation, Partial Access for E&E	5-Oct-17	
WLO-05	Station Platform, Partial Access Systems Installation	7-Oct-17	
WLO-02	Balance of Building and Structures, Partial Access for Systems Installation	29-Dec-17	
WTC-01	Auxiliary Equipment Building/TCCR, Partial Access for Systems Installation	9-Jan-18	
WTC-05	Station Platform, Partial Access Systems Installation	14-Feb-18	
WTC-04	Elevator & Escalators Installation, Partial Access for E&E	30-Mar-18	
WTC-02	Balance of Building and Structures, Partial Access for Systems Installation	7-Apr-18	
LCC-01	Auxiliary Equipment Building/TCCR, Partial Access for Systems Installation	2-May-18	
LCC-04	Elevator & Escalators Installation, Partial Access for E&E	5-May-18	
LCC-05	Station Platform, Partial Access Systems Installation	5-May-18	
LCC-02	Balance of Building and Structures, Partial Access for Systems Installation	20-Jun-18	
WLO-08	CSC provided Full Access @ Station Construction Completion		6-Nov-18
LCC-08	CSC provided Full Access @ Station Construction Completion		30-Jan-19
WTC-08	CSC provided Full Access @ Station Construction Completion		26-Feb-19
	Kamehameha Highway Segment		
X0100031-AS	3.1 (KHG -> KHSG) Access for to ALS Site (Except Station Footprint) (6/19/17) - AS	19-Jun-17	
X010002c-PR	2c (KHG -> KHSG) Access to Guideway Platform Deck Construction (11/15/17) - PR	13-Nov-17	
X0100032-AS	3.2 (KHG -> KHSG) Access to Balance of ALS Site (Includes Station Footprint) (11/15/17) - AS	15-Nov-17	
X010003c-AS	3c (KHG -> KHSG) Access to Guideway Platform Deck Construction (12/18/17) - AS	18-Dec-17	
X010001a-PH	1a (KHSG -> CSC) Access to TCCR & UPS (11/29/17) - PH	30-Jan-18	

Activity ID	Activity Name	Early Start	Early Finish
X010002a-PR	2a (KHSG -> CSC) Access to TCCR & UPS (2/15/18) - PR	1-Mar-18	
X010001b-PH	1b (KHSG -> CSC) Access to Balance of Building & Structure (2/15/18) - PH	13-Apr-18	
X010002b-PR	2b (KHSG -> CSC) Access to Balance of Building & Structure (5/18/18) - PR	16-Apr-18	
X010001e-PH	1e (KHSG -> CSC) Access to Station Platform (4/17/18) - PH	8-Jun-18	
X010002d-PR	2d (KHSG -> E&E) Access to Install E&E (8/17/18) - PR	26-Jun-18	
X010002e-PR	2e (KHSG -> CSC) Access to Station Platform (6/18/18) - PR	29-Jun-18	
X010001d-PH	1d (KHSG -> E&E) Access to Install E&E (5/18/18) - PH	16-Jul-18	
X010003a-AS	3a (KHSG -> CSC) Access to TCCR & UPS (5/18/18) - AS	25-Jul-18	
X010003b-AS	3b (KHSG-> CSC) Access to Balance of Building & Structure (7/18/18) - AS	7-Sep-18	
X010003d-AS	3d (KHSG -> E&E) Access to Install E&E (10/18/18) - AS	7-Sep-18	
X010003e-AS	3e (KHSG -> CSC) Access to Station Platform (8/17/18) - AS	12-Oct-18	
KHG			
MIL 7	CSC Partial Access on Deck to Install Cabling		30-Dec-16
MIL 4	Station Contractor Access to Deck @ Aloha Stadium Station for Platform Erection		25-Jan-17
MIL 3	Station Contractor Access to Deck @ Pearlridge Station for Platform Erection		30-Mar-17
MIL 6	CSC Partial Access to At Grade Ductbanks/TPSS Pads (SS#10 and 24)		26-Apr-17
WOSG	West Oahu/Farrington Highway Segment		
X010000H03	ID Number 3a: HOP-TCCR/UPS rooms, Partial Access for Systems Installation (6/6/16)	10-Mar-17	
X010000H11	ID Number 3e: HOP-Station Platform, Partial Access for Systems Installation (9/6/16)	6-May-17	
X010000H05	ID Number 3b: HOP-Balance of Building and Structures, Partial Access for Systems Installation (8/6/16)	15-Jun-17	
X010000W03	ID Number 2a: UHWO-TCCR/UPS Building, Partial Access for Systems Installation (9/6/16)	7-Sep-17	
X010000E05	ID Number 1a: EKP-TCCR and UPS rooms, Partial Access for Systems Installation (1/6/17)	23-Sep-17	
X010000W11	ID Number 2e: UHWO-Station Platform, Partial Access for Systems Installation (12/7/16)	30-Sep-17	
X010000H19	ID Number 3d: HOP-Elevator (#2) & Escalators Installation, Partial Access for E&E (12/7/16)	31-Oct-17	
X010000H21	ID Number 3d: HOP-Elevator (#1) & Escalators Installation, Partial Access for E&E (12/7/16)	31-Oct-17	
X010000H17	ID Number 3h: HOP-CSC provided Full Access @ Station Construction Completion (6/5/17)	22-Nov-17	
X010000E07	ID Number 1b: EKP-Balance of Building and Structures, Partial Access for System Installation (3/8/17)	20-Dec-17	
X010000E13	ID Number 1e: EKP-Station Platform, Partial Access for Systems Installation (4/8/17)	4-Jan-18	
X010000W05	ID Number 2b: UHWO-Balance of Building and Structures, Partial Access for Systems Installation (1/6/17)	5-Jan-18	
X010000E11	ID Number 1d: EKP-Elevator (#1) and Escalators Installation, Partial Access for E&E (7/7/17)	17-Mar-18	

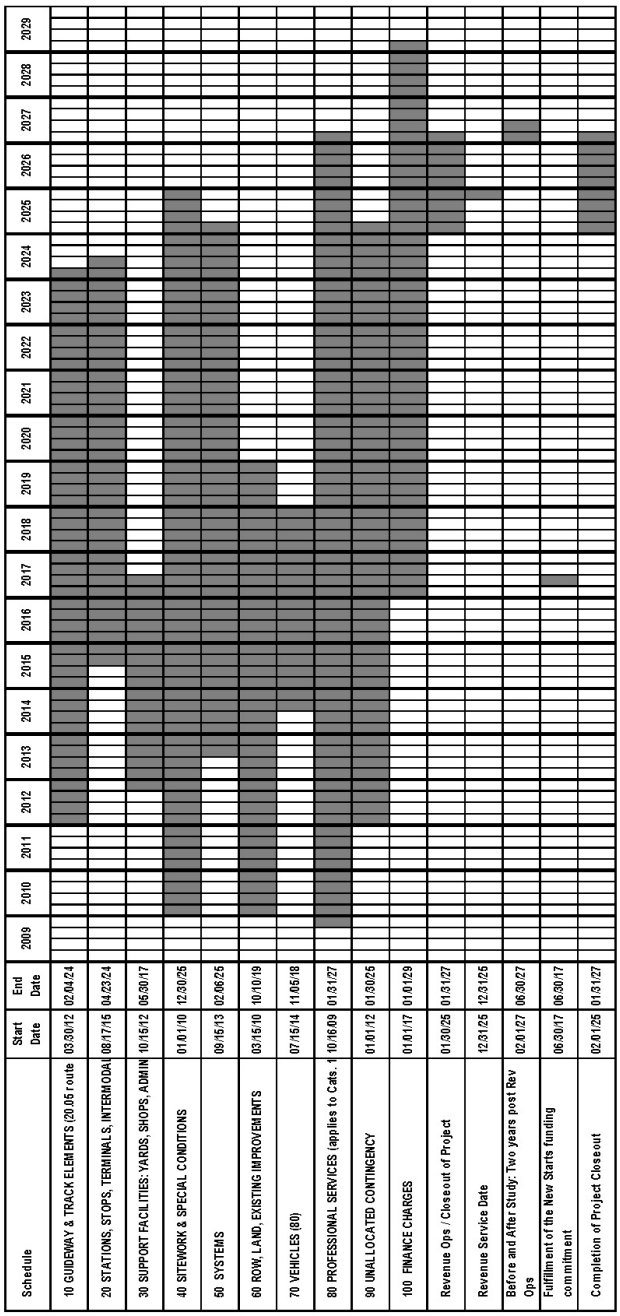
Activity ID	Activity Name	Early Start	Early Finish
X010000E21	ID Number 1d: EKP-Elevator & Escalators Installation, Partial Access for E&E (7/7/17)	28-Mar-18	
X010000W09	ID Number 2d: UHWO-Elevator (#1) & Escalators Installation Partial Access for E&E (4/8/17)	11-Apr-18	
X010000W19	ID Number 2d: UHWO-Elevator (#5) & Escalators Installation, Partial Access for E&E (4/8/17)	11-Apr-18	
X010000W21	ID Number 2d: UHWO-Elevator (#3) & Escalators Installation, Partial Access for E&E (4/8/17)	11-Apr-18	
X010000W23	ID Number 2d: UHWO-Elevator & Escalator Installation, Partial Access for E&E (4/8/17)	11-Apr-18	
X010000E19	ID Number 1h: EKP-CSC provided Full Access at Station Construction Completion (1/5/18)	21-Apr-18	
X010000W17	ID Number 2h: UHWO-CSC provided Full Access at Station Construction Completion (11/5/17)	30-May-18	
CCGS HART	Core Systems Stations Install		
ST12LD1480	CSC Access at AUX Equip Bldg/TCCR-3A at LGD		26-Jul-18
ST10NV1480	CSC Access at AUX Equip Bldg/TCCR-3A at PNB		27-Nov-18
ST12LD1740	CSC Partial Access Balance of Station Structure-3B at LGD		13-Mar-19
ST13MS1480	CSC Access at AUX Equip Bldg/TCCR-8A at MTC		28-May-19
ST11HN1480	CSC Access at AUX Equip Bldg/TCCR-8A at ARP		14-Jun-19
ST12LD1950	Lagoon Dr - CSC FULL ACCESS IN STA-3H		20-Jun-19
ST12LD1840	CSC Partial Platform Access for CSC Install-3E at LGD		11-Sep-19
ST13MS1740	CSC Partial Access Balance of Station Structure-8B at MTC		20-Sep-19
ST11HN1740	CSC Partial Access Balance of Station Structure-8B at ARP		8-Oct-19
ST10NV1740	CSC Partial Access Balance of Station Structure-3B at PNB		1-Nov-19
ST10NV1840	CSC Partial Platform Access for CSC Install-3E at PNB		18-Dec-19
ST10NV1950	Pearl Harbor - CSC FULL ACCESS IN STA-3H		17-Jan-20
ST13MS1840	CSC Partial Platform Access for CSC Install-8E at MTC		2-Nov-20
ST13MS1950	Middle Street Station - CSC FULL ACCESS IN STA-8H		21-Jun-21
ST11HN1840	CSC Partial Platform Access for CSC Install-8E at ARP		14-Jul-21
ST11HN1950	HNL Airport - CSC FULL ACCESS IN STA-8H		8-Dec-21
	Airport Guideway and Stations		
ST12LD1360	Station Contractor Access to GW for Platform Erection	24-Dec-18	
ST12LDEE10	E&E Contractor Partial Access to Install Elev/Escalators	8-Jan-19	
ST10NVEE10	E&E Contractor Partial Access to Install Elev/Escalators	20-Jun-19	
ST10NV1360	Station Contractor Access to GW for Platform Erection	26-Aug-19	
ST13MS1360	Station Contractor Access to GW for Platform Erection	25-Mar-20	
ST11HN1360	Station Contractor Access to GW for Platform Erection	1-Dec-20	
ST13MSEE10	E&E Contractor Partial Access to Install Elev/Escalators	22-Feb-21	
ST11HNEE10	E&E Contractor Partial Access to Install Elev/Escalators	25-Aug-21	
	Details of Rail Activation Schedule		
A2195	Access to Hoopili System #3		28-Feb-17
A1840	Access to Guideway West Loch		28-Feb-17
A1862	Access to Guideway East Kapolei		1-Mar-17
A1818	Access to Guideway LCC		3-Apr-17
A2178	Access to LCC SS#9		1-May-17
A1807	Access to Guideway Pearl Higland		1-May-17
A2127	Access to Pearlridge SS#12		1-Jun-17
A1796	Access to Guideway Pearlridge		1-Jun-17

Activity ID	Activity Name	Early Start	Early Finish
A1785	Access to Guideway Aloha Stadium		1-Aug-17
A1639	TCCR Access Fixed Facilities (25250) West Loch		30-Sep-17
A1578	TCCR Access (25250) West Loch		30-Sep-17
A1836	Access to TCCR (25250) West Loch		30-Sep-17
A2416	Access to TCCR West Loch	30-Sep-17	
A2413	TCCR Access Fixed Facilities West Loch		30-Sep-17
A1616	Partial Access to Platform (37880) Hoopili		30-Oct-17
A1605	TCCR Access Fixed Facilities (26740) Hoopili		30-Oct-17
A1577	TCCR Access (26740) Hoopili		30-Oct-17
A1847	Access to TCCR (26740) Hoopili		30-Oct-17
A2464	Access to TCCR Hoopili	30-Oct-17	
A2461	TCCR Access Fixed Facilities Hoopili		30-Oct-17
A2113	Access to Aloha Stadium SS#24		1-Nov-17
A2488	Access to TCCR UH West Oahu	30-Jan-18	
A2485	TCCR Access Fixed Facilities UH West Oahu		30-Jan-18
A1576	TCCR Access East Kapolei	30-Jan-18	
A1858	Access to TCCR East Kapolei		30-Jan-18
A2005	TCCR Access Fixed Facilities East Kapolei		30-Jan-18
A2015	Access to TCCR East Kapolei	30-Jan-18	
A1573	TCCR Access UHWO		30-Jan-18
A1581	TCCR Access Pearl Highland		28-Feb-18
A1803	Access to TCCR Pearl Higland		28-Feb-18
A1937	TCCR Access Fixed Facilities (28570) Pearl Highland		28-Feb-18
A1947	Access to TCCR (28570) Pearl Highland	28-Feb-18	
A1101	TCCR Access Fixed Facilities (22550) Waipahu		13-Mar-18
A1825	Access to TCCR (22550) Waiphau		13-Mar-18
A2440	Access to TCCR Waiphau	13-Mar-18	
A2437	TCCR Access Fixed Facilities Waiphau		13-Mar-18
A1579	TCCR Access (26740) Waipahu		13-Mar-18
A1650	Partial Access to Platform (37310) West Loch	30-Apr-18	
A2016	Partial Access to Platform East Kapolei	30-Apr-18	
A1582	TCCR Access Pearlridge		30-May-18
A1580	TCCR Access LCC		30-May-18
A1792	Access to TCCR Pearlridge		30-May-18
A1814	Access to TCCR LCC		30-May-18
A1872	Access to TCCR (35680) Pearlridge		30-May-18
A1879	Access to TCCR (35680) Pearlridge	30-May-18	
A1971	TCCR Access Fixed Facilities LCC		30-May-18
A1981	Access to TCCR LCC	30-May-18	
A1948	Partial Access to Platform (38360) Pearl Highland	30-Jul-18	
A1914	Partial Access to Platform (37290) Aloha Stadium	8-Aug-18	
A1170	Partial Access to Platform (35830) Waipahu	30-Aug-18	
A2441	Partial Access to Platform Waiphau	30-Aug-18	
A1781	Access to TCCR Aloha Stadium		30-Aug-18
A1903	TCCR Access Fixed Facilities (32990) Aloha Stadium		30-Aug-18
A1913	Access to TCCR (32990) Aloha Stadium	30-Aug-18	
A1880	Partial Access to Platform (41700) Pearlridge	30-Sep-18	
A1982	Partial Access to Platform LCC	30-Jan-19	

Activity ID	Activity Name	Early Start	Early Finish
WOFH - 98 Progress Schedule			
MIL 10	CSC Partial Access on deck to install Cabling (Sta 650 to 730)		30-Dec-16
MIL 11	CSC Partial Access on deck to install Cabling (Sta 730 to 760)		30-Dec-16
MIL 07	CSC Partial Access to at grade balance of Ductbank for SS #8		30-Dec-16
MIL 08	CSC Partial Access to at grade TPSS Pad/Ductbank for SS #9		30-Dec-16
MIL 13	Station Contractor Access to Waipahu Station for Platform Erection (7/15/2015)		10-Jan-17
MIL 12	Station Contractor Access to LCC Station for Platform Erection		8-May-17
Guideway			
CO.137.00086.003	LCC Access Structure - FPS Walls		30-Dec-16
CO.137.00086.004	LCC Access Structure - FPS Suspended Slabs		30-Dec-16
CO.137.00086.010	LCC Access Structure - Construct Aesthetic Treatment on Retaining Wall		30-Dec-16
CORE SYSTEMS	FUNCTIONAL TEST TRACK (Hoopili to Waipahu)		
A1101	TCCR Access Fixed Facilities (22550) Waipahu		13-Mar-18
A1170	Partial Access to Platform (35830) Waipahu	30-Aug-18	
A1577	TCCR Access (26740) Hoopili		30-Oct-17
A1578	TCCR Access (25250) West Loch		30-Sep-17
A1579	TCCR Access (26740) Waipahu		13-Mar-18
A1605	TCCR Access Fixed Facilities (26740) Hoopili		30-Oct-17
A1616	Partial Access to Platform (37880) Hoopili		30-Oct-17
A1639	TCCR Access Fixed Facilities (25250) West Loch		30-Sep-17
A1650	Partial Access to Platform (37310) West Loch	30-Apr-18	
A1825	Access to TCCR (22550) Waiphau		13-Mar-18
A1836	Access to TCCR (25250) West Loch		30-Sep-17
A1840	Access to Guideway West Loch		28-Feb-17
A1847	Access to TCCR (26740) Hoopili		30-Oct-17
A2195	Access to Hoopili System #3		28-Feb-17
ACTIVATION			
A1573	TCCR Access UHWO		30-Jan-18
A1576	TCCR Access East Kapolei	30-Jan-18	
A1580	TCCR Access LCC		30-May-18
A1581	TCCR Access Pearl Highland		28-Feb-18
A1582	TCCR Access Pearlridge		30-May-18
A1781	Access to TCCR Aloha Stadium		30-Aug-18
A1785	Access to Guideway Aloha Stadium		1-Aug-17
A1792	Access to TCCR Pearlridge		30-May-18
A1796	Access to Guideway Pearlridge		1-Jun-17
A1803	Access to TCCR Pearl Higland		28-Feb-18
A1807	Access to Guideway Pearl Higland		1-May-17
A1814	Access to TCCR LCC		30-May-18
A1818	Access to Guideway LCC		3-Apr-17
A1858	Access to TCCR East Kapolei		30-Jan-18
A1862	Access to Guideway East Kapolei		1-Mar-17
A1872	Access to TCCR (35680) Pearlridge		30-May-18
A1879	Access to TCCR (35680) Pearlridge	30-May-18	

Activity ID	Activity Name	Early Start	Early Finish
A1880	Partial Access to Platform (41700) Pearlridge	30-Sep-18	
A1903	TCCR Access Fixed Facilities (32990) Aloha Stadium		30-Aug-18
A1913	Access to TCCR (32990) Aloha Stadium	30-Aug-18	
A1914	Partial Access to Platform (37290) Aloha Stadium	8-Aug-18	
A1937	TCCR Access Fixed Facilities (28570) Pearl Highland		28-Feb-18
A1947	Access to TCCR (28570) Pearl Highland	28-Feb-18	
A1948	Partial Access to Platform (38360) Pearl Highland	30-Jul-18	
A1971	TCCR Access Fixed Facilities LCC		30-May-18
A1981	Access to TCCR LCC	30-May-18	
A1982	Partial Access to Platform LCC	30-Jan-19	
A2005	TCCR Access Fixed Facilities East Kapolei		30-Jan-18
A2015	Access to TCCR East Kapolei	30-Jan-18	
A2016	Partial Access to Platform East Kapolei	30-Apr-18	
A2113	Access to Aloha Stadium SS#24		1-Nov-17
A2127	Access to Pearlridge SS#12		1-Jun-17
A2178	Access to LCC SS#9		1-May-17
A2413	TCCR Access Fixed Facilities West Loch		30-Sep-17
A2416	Access to TCCR West Loch	30-Sep-17	
A2437	TCCR Access Fixed Facilities Waiphau		13-Mar-18
A2440	Access to TCCR Waiphau	13-Mar-18	
A2441	Partial Access to Platform Waiphau	30-Aug-18	
A2461	TCCR Access Fixed Facilities Hoopili		30-Oct-17
A2464	Access to TCCR Hoopili	30-Oct-17	
A2485	TCCR Access Fixed Facilities UH West Oahu		30-Jan-18
A2488	Access to TCCR UH West Oahu	30-Jan-18	

Appendix C *Summary Schedule*



Schedule	Start Date	End Date
10 GUIDEWAY & TRACK ELEMENTS (20.05 route	03/30/12	02/04/24
20 STATIONS, STOPS, TERMINALS, INTERMODAL	08/17/15	04/23/24
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN	10/15/12	06/30/17
40 SITEWORK & SPECIAL CONDITIONS	01/01/10	12/30/25
50 SYSTEMS	09/15/13	02/06/25
60 ROW, LAND, EXISTING IMPROVEMENTS	03/15/10	10/10/19
70 VEHICLES (80)	07/15/14	11/05/18
80 PROFESSIONAL SERVICES (applies to Cats. 1	10/16/09	01/31/27
90 UNALLOCATED CONTINGENCY	01/01/12	01/30/25
100 FINANCE CHARGES	01/01/17	01/01/29
Revenue Ops / Closeout of Project	01/30/25	01/31/27
Revenue Service Date	12/31/25	12/31/25
Before and After Study: Two years post Rev Ops	02/01/27	06/30/27
Fulfillment of the New Starts funding commitment	06/30/17	06/30/17
Completion of Project Closeout	02/01/25	01/31/27

Appendix H: Ridership Forecasts

H-1 Four-Car Trains

Project ridership forecasts were updated in 2013 when HART switched the operating plans from a mixed fleet operation to fixed, four-car trainsets running at slightly longer headways. At that time, the travel demand forecasting model parameters were also updated to better differentiate rail from traditional bus services. These new model parameters accounted for factors such as reliability, passenger amenities, increased seating, and schedule-free services.[1] At the time of the FFGA, analysts estimated that 114,400 daily passengers would use the rail transit system in 2030.[2]

Using the four-car methodology, approximately 119,600 daily passengers were expected to use the system, or an increase of approximately 5% relative to the FFGA forecast. Overall, these forecasts remained consistent with the range of ridership estimates included in the technical studies that were part of the FEIS.

H-2 Regional Model Update

In 2016, HART began using the latest Oahu MPO travel demand forecasting model. This new tour-based model uses the TransCAD 6.1 software platform and is faster and more robust than the previous MINUTP model. The geographic information systems-based model incorporates updates to long-range population and land use forecasts from the City and County of Honolulu Department of Planning and Permitting, as well as travel behavior data from 2012 surveys of households, visitors, and transit riders. The new model also updates the committed short-range highway and transit projects included in the regional transportation plan which are likely to be completed by 2030. The new model retains the supporting bus network described in the Project's FEIS, although ferry routes and associated feeder buses (eliminated in 2009) were removed from the model.

A comparison of the FFGA, Four-Car Model, and Updated Project Model (Oahu MPO) ridership forecasts by means of station access are shown in Exhibit H-1. The new model forecasts approximately 121,600 rail passengers per day in 2030. This is approximately 2% higher than the four-car model forecast and 6% higher than the FFGA forecast. The new forecasts predict that approximately 55% of rail passengers (67,300 passengers) will walk to a station—an increase from 28% in the previous forecasts. The share of rail passengers connecting from a feeder bus decreases from 60% in the previous forecast down to 36% (44,100 daily passengers). Formal park-and-ride demand decreases from approximately 7% of all rail trips down to approximately 5% of all trips.

[1] The new model parameters are called non-included attributes.
[2] Based on an end-to-end running time of 44.3 minutes, a peak headway of 2.4 minutes, and an off-peak headway of 4.7 minutes.

Exhibit H-2 shows the boarding and alighting patterns for the 22,600 east-bound rail passengers during the A.M. Peak Period (6 a.m. to 9 a.m.) by station mode of access. Approximately 66% of the east-bound passengers board the rail system west of the Aloha Stadium Station. In addition, approximately 40% of the alightings occurs at stations east of Downtown Honolulu (about 9,000 alightings). Exhibit H-3 shows the 8,900 west-bound boardings and alightings. Approximately half of the west-bound boardings occur east of the Downtown Station (4,400 boardings).

Exhibit H-1 Comparison of HRTP Ridership Forecasts, Daily Rail System Boardings, 2030

Forecast (Date)	Means of Station Access				
	Walk/ Bike	Bus	Drop Off	Parking	Total
FFGA Forecast (2/2012)	28,850	61,370	9,240	14,890	114,350
Four-Car Model (8/2013)	33,420	71,320	5,580	9,270	119,590
Updated Model (1/2017)	67,320	44,090	3,300	6,910	121,620

Exhibit H-2 East-bound Rail Boardings/Alightings, A.M. Peak Period (6 a.m.–9 a.m.), 2030

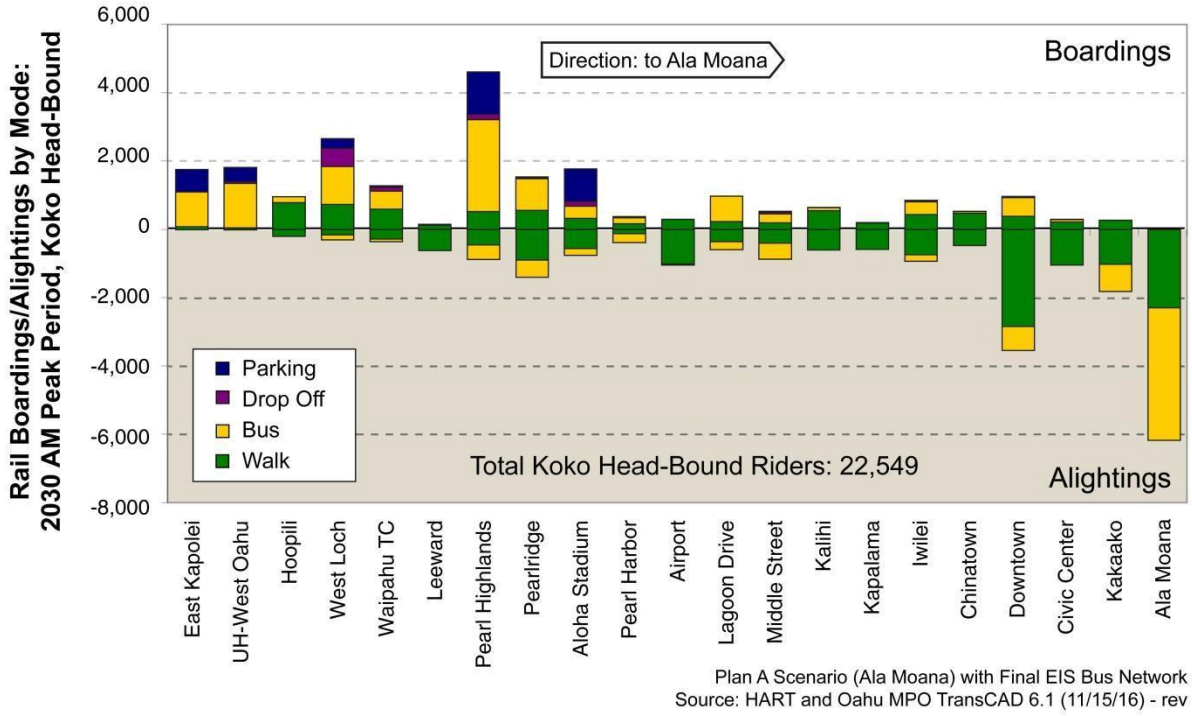
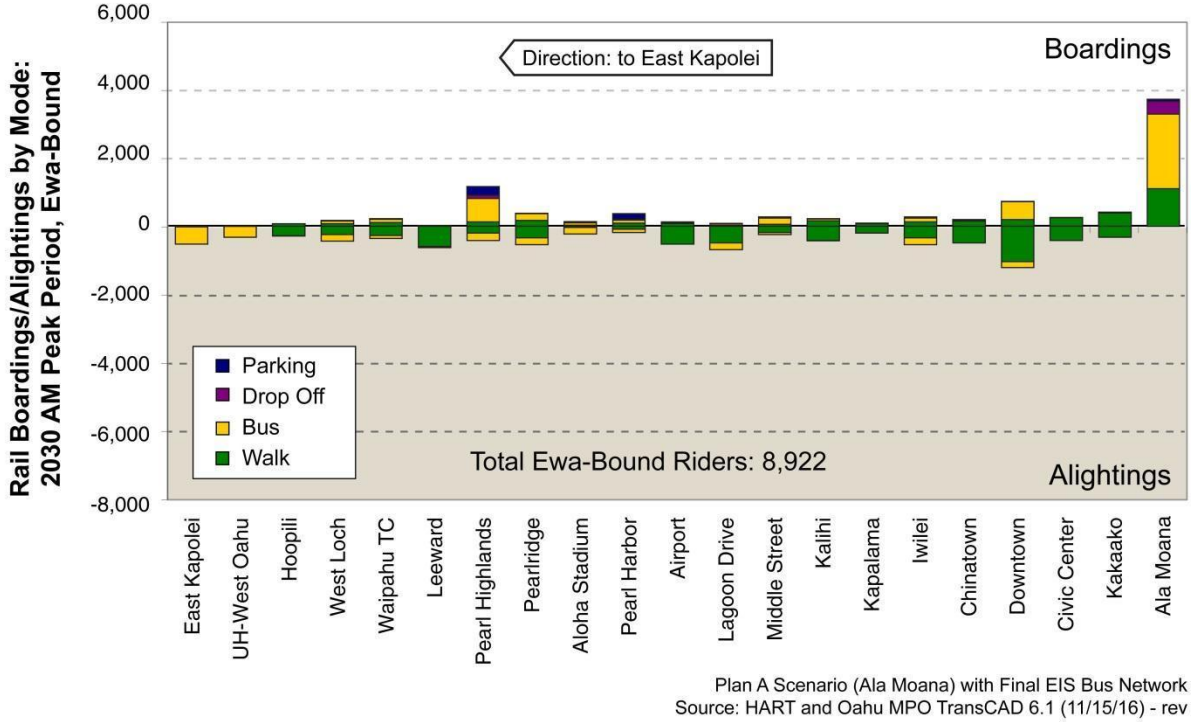


Exhibit H-3 West-bound Rail System Boardings/Alightings, A.M. Peak Period (6 a.m.–9 a.m.), 2030



Plan A Scenario (Ala Moana) with Final EIS Bus Network
Source: HART and Oahu MPO TransCAD 6.1 (11/15/16) - rev

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Appendix I: HECO Relocations and Related Issues

I-1 138kV, 46kV, and 12kV Overhead Power Line Working Clearance Resolution

HART and HECO have come to an agreement to resolve HECO's concerns regarding adequate working clearances between HART's rail guideway and HECO's high-voltage 138kV transmission, 46kV sub-transmission, and 12kV distribution power lines and the associated steel or wood poles. In order for HECO's work crews to perform future maintenance, repairs, or pole replacements (utilizing their existing fleet of bucket truck vehicles), HECO has required horizontal working clearances of 50 feet for 138kV power lines, 40 feet for 46kV power lines, and 30 feet for 12kV power lines. In relation to the Project, this is the horizontal distance between HECO's overhead conductors and the HRTP's edge of guideway. HART was able to work with HECO to research and identify alternate equipment (vehicles) which would allow HECO's work to be performed in less horizontal space than originally required. With the use of these alternate vehicles, HECO has granted variances to their clearance requirements in certain areas that will enable existing poles to remain overhead and not be relocated as originally contemplated.

HART assembled a Task Force to review and analyze mitigation options to the clearance issue, which explored both relocation and non-relocation alternatives. Some non-relocation alternatives that were discussed with HECO included "re-framing" poles, maintaining poles from alternate access areas, and using alternate vehicles. Re-framing is an adjustment of how the power line conductor attaches to the structural steel pole by eliminating (or shortening) the existing pole arms and relocating the insulator and conductor closer to the pole, resulting in additional clearance to the HRTP guideway. With re-framing, additional analysis of the adjacent poles were required to ensure any angle changes in the power lines can be supported by the adjacent existing structural poles. The review of alternate access areas included performing a pole-by-pole analysis of the HECO alignment to confirm if any frontage roads (such as Moloalo Street) or private property could be used to access poles, rather than the public right-of-way. Allowing HECO to work from the guideway was also reviewed and discussed, but this didn't provide adequate solutions to allow for HECO to perform its work. Alternate vehicles were another explored alternative and have become the primary solution to resolve the HECO clearance concerns. HECO successfully tested two new bucket trucks that can perform the 46kV work and two additional high-reach bucket trucks that can perform the 138kV work within less than their required horizontal working clearance.

Alternatives for relocation of HECO facilities were also analyzed to mitigate cost and schedule. Traditional overhead and underground relocations were considered, with the cost-effective overhead relocations being the preferred solution. Relocating HECO's lines and attaching them to the rail guideway was another option considered; however, this option posed access and maintenance challenges for both agencies and was not pursued.

For the WOFH and KHG sections of the Project, HECO successfully tested two new bucket trucks (the Altec AN67-E100 and Altec TA45-L55, which are not currently in their fleet) that can perform the 46kV and 12kV maintenance work with less than their required working clearance. This will mitigate the need to relocate almost 90% of the 46kV poles/lines that do not meet the required working clearances. For the 138kV lines along WOFH and KHG, HECO and HART traveled to Colorado to review the operational capabilities of the Phoenix and Skybird bucket trucks. The Phoenix has an upward reach of 180 feet, a side reach of 79 feet, and a platform carrying capacity of 2,000 pounds. The Skybird has an upward reach of 210 feet, a side reach of 102 feet, and a platform carrying capacity of 1,300 pounds. HECO has also found alternate cranes which will allow for less than the required working clearance. HECO has determined the extent of their power lines that can be addressed through the use of this new equipment and has granted variances on a case-by-case basis where possible. Variances include the 138kV lines along Kualakai Parkway and along Kamehameha Highway (west of HECO's Waiau Power Plant). HART is working to finalize the design for the additional necessary 46kV relocations along the WOFH section and is working to procure a designer to finalize the additional necessary 138kV relocations along the KHG section (east of HECO's Waiau Power Plant). For the Airport section of the Project, a HECO-HART combined solution of the use of alternate vehicles (identified on the west side), increased Navy easements, and redesigned (re-framed) pole arms will alleviate undergrounding the nine-pole 138kV system fronting Joint Base Pearl Harbor-Hickam. This solution will not require underground relocations of this 138kV system. For the City Center section of the Project, HART and HECO have agreed to underground the two existing overhead 138kV lines along Dillingham Boulevard. HECO's 46kV and 12kV lines were already considered for relocation in the CCGS procurement, and HART's designers are progressing to a preliminary engineering 138kV design with feedback from HECO.

HECO has provided a report for the 138kV alternate equipment and a separate report which covers the 46kV and 12kV alternate equipment. HART is required to purchase these alternate vehicles for HECO's future use, which will allow variances to HECO's clearance requirements and thus avoid costly line relocations (underground or overhead). As presented to HART's Board of Directors, the total underground relocation estimate for the 138kV and 46kV lines along the WOFH and KHG sections is estimated to be $200 million. With the alternate vehicles, a potential savings of $138 million is possible.

The equipment option costs are presented in the following exhibit, which includes relocation costs for WOFH and KHG (for those portions for which alternate equipment would not work and thus have to be relocated):

Exhibit I-1: HECO Equipment and Relocation Costs

Equipment/Relocation Option	Cost
Altec Vehicle Cost for 46kV	$ 4,741,000
Skybird and Phoenix Cost for 138kV	9,076,000
46kV and 12kV Relocation (WOFH)	5,700,000
138kV Underground Relocation (KHG)	32,000,000
46kV Overhead on Shorter Poles (KHG)	10,000,000
Total Cost with Vehicle Purchase	**$61,517,000**

For the Airport section, the 138kV underground relocation was included as a priced option, and HECO provided a letter allowing for the nine existing 138kV poles to remain in place by being re-framed to provide more horizontal working space. For the City Center section, the 138kV relocations are included in the contractor's base scope. The overall solution for the Project consists of a variety of alternative solutions for each section of the alignment to either allow for a variance from the standard requirements or to perform the necessary relocations to allow for acceptable working clearances, as outlined below and as shown in Exhibit I-2:

Exhibit I-2: HECO Relocation Solutions by HRTP Section

HRTP Section	Relocation Solutions
WOFH	138kV – No relocations with use of Alternate Vehicles. 46kV – No relocations with use of Alternate Vehicles except in two areas that will require overhead-to-overhead relocations.
KHG	138kV – No relocations for certain poles with use of Alternate Vehicles; relocation of overhead line to underground where variances were not granted. 46kV – Where 46kV lines are "under-built" to 138kV lines, replacement 46kV poles are required and allow for demolition of 138kV poles.
Airport	138kV – Re-frame poles (shorten conductor arms); no relocations with use of Alternate Vehicles. 46kV – No relocations with use of Alternate Vehicles.
City Center	138kV – Relocation of overhead lines to underground is included in the base scope. 46kV – Relocation of overhead lines to underground is included in the base scope.

I-3 Davis-Bacon Requirements

HECO has a collective bargaining agreement that has different wage scales and allows payment to its labor forces bi-weekly, which does not satisfy the federal Davis-Bacon Act. Based on the State of Hawaii Department of Labor and Industrial Relations correspondence, HECO has begun the process to pay their employees weekly. HECO has submitted a rate conformance request that has thus far been denied by the United States Department of Labor (USDOL), although HECO has appealed. HECO and HART are still awaiting a final decision from the USDOL for the applicable rates.

Appendix J: Operating Plan Methodology and Scenarios

Exhibit J-1: Operating Plan, Continue Original Plan Methodology

City Fiscal Year	Units	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
Operating Revenues																					
Fare Revenues (Bus)	YOE $M	55	58	59	72	80	86	100	101	102	84	93	94	95	96	112	113	114	115	116	117
Fare Revenues (Rail)	YOE $M	-	-	-	-	3	3	4	4	4	40	45	46	47	47	56	57	58	59	60	61
Fare Revenues (Handi-Van)	YOE $M	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Total Fare Revenues	**YOE $M**	**57**	**60**	**62**	**74**	**85**	**91**	**106**	**107**	**108**	**126**	**141**	**143**	**144**	**146**	**172**	**174**	**176**	**178**	**180**	**182**
Federal Operating Assistance																					
Total Federal Operating Assistance	**YOE $M**	**23**	**10**	**10**	**11**	**10**	**10**	**6**	**10**	**-**	**9**	**6**	**-**	**-**	**5**	**1**	**1**	**4**	**5**	**5**	**-**
Local Operating Assistance																					
Transfer from Project	YOE $M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
City Operating Subsidy	YOE $M	176	197	207	207	248	287	307	330	366	389	420	448	472	486	488	508	532	562	597	632
Total Local Operating Assistance	**YOE $M**	**176**	**197**	**207**	**207**	**248**	**287**	**307**	**330**	**366**	**389**	**420**	**448**	**472**	**486**	**488**	**508**	**532**	**562**	**597**	**632**
Total Operating Revenues	**YOE $M**	**256**	**268**	**279**	**292**	**343**	**389**	**419**	**447**	**475**	**524**	**567**	**591**	**616**	**638**	**661**	**683**	**712**	**745**	**781**	**814**
Operations and Maintenance (O&M) Costs																					
TheBus O&M Costs	YOE $M	204	212	220	229	238	247	257	268	291	309	342	358	374	391	409	428	448	469	490	513
Rail O&M Costs	YOE $M	-	-	-	-	39	71	87	100	101	127	130	133	136	134	135	133	136	142	151	154
TheHandi-Van O&M Costs	YOE $M	52	55	58	61	65	68	72	76	80	85	89	94	99	104	109	114	120	126	132	138
Other O&M Costs	YOE $M	1	1	1	2	2	2	3	3	3	3	5	6	7	8	8	8	8	8	8	8
Total O&M Costs	**YOE $M**	**256**	**268**	**279**	**292**	**343**	**389**	**419**	**447**	**475**	**524**	**567**	**591**	**616**	**638**	**661**	**683**	**712**	**745**	**781**	**814**
Farebox Recovery Ratio (Bus and Rail)		**27%**	**27%**	**27%**	**32%**	**30%**	**28%**	**30%**	**28%**	**27%**	**28%**	**29%**	**28%**	**28%**	**27%**	**31%**	**30%**	**30%**	**29%**	**28%**	**27%**

Exhibit J-2: Operating Plan, Moderate Range Scenario

City Fiscal Year	Units	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
Operating Revenues																					
Fare Revenues (Bus & Rail)	YOE $M	55	58	59	72	83	89	104	105	106	124	138	140	141	143	154	156	173	175	177	186
Fare Revenues (Handi-Van)	YOE $M	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Total Fare Revenues	**YOE $M**	**57**	**60**	**62**	**74**	**85**	**91**	**106**	**107**	**108**	**126**	**141**	**143**	**144**	**146**	**157**	**159**	**176**	**178**	**180**	**189**
Federal Operating Assistance																					
Total Federal Assistance	**YOE $M**	**23**	**10**	**10**	**11**	**10**	**10**	**6**	**10**	**-**	**9**	**6**	**-**	**-**	**5**	**1**	**1**	**4**	**5**	**5**	**-**
Local Operating Assistance																					
Transfer from Project	YOE $M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
City Operating Subsidy	YOE $M	176	197	207	207	248	287	307	330	366	398	431	458	483	498	514	535	545	575	611	640
Total Local Assistance	**YOE $M**	**176**	**197**	**207**	**207**	**248**	**287**	**307**	**330**	**366**	**398**	**431**	**458**	**483**	**498**	**514**	**535**	**545**	**575**	**611**	**640**
Total Operating Revenues	**YOE $M**	**256**	**268**	**279**	**292**	**343**	**389**	**419**	**447**	**475**	**534**	**577**	**601**	**627**	**650**	**673**	**696**	**725**	**758**	**795**	**829**
Operations and Maintenance (O&M) Costs																					
TheBus O&M Costs	YOE $M	204	212	220	229	238	247	257	268	291	309	342	358	374	391	409	428	448	469	490	513
Rail O&M Costs	YOE $M	-	-	-	-	39	71	87	100	101	137	141	143	147	146	146	145	149	156	165	169
TheHandi-Van O&M Costs	YOE $M	52	55	58	61	65	68	72	76	80	85	89	94	99	104	109	114	120	126	132	138
Other O&M Costs	YOE $M	1	1	1	2	2	2	3	3	3	3	5	6	7	8	8	8	8	8	8	8
Total O&M Costs	**YOE $M**	**256**	**268**	**279**	**292**	**343**	**389**	**419**	**447**	**475**	**534**	**577**	**601**	**627**	**650**	**673**	**696**	**725**	**758**	**795**	**829**
Farebox Recovery (Bus and Rail)		**27%**	**27%**	**27%**	**32%**	**30%**	**28%**	**30%**	**28%**	**27%**	**28%**	**29%**	**28%**	**27%**	**27%**	**28%**	**27%**	**29%**	**28%**	**27%**	**27%**

Exhibit J-3: Operating Plan, High Cost Range Scenario

City Fiscal Year	Units	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
Operating Revenues																					
Fare Revenues (Bus & Rail)	YOE $M	55	58	59	72	83	89	104	105	106	124	138	140	156	157	159	161	183	185	187	189
Fare Revenues (Handi-Van)	YOE $M	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Total Fare Revenues	**YOE $M**	**57**	**60**	**62**	**74**	**85**	**91**	**106**	**107**	**108**	**126**	**141**	**143**	**158**	**160**	**162**	**164**	**186**	**188**	**190**	**192**
Federal Operating Assistance																					
Total Federal Assistance	**YOE $M**	**23**	**10**	**10**	**11**	**10**	**10**	**6**	**10**	**-**	**9**	**6**	**-**	**-**	**5**	**1**	**1**	**4**	**5**	**5**	**-**
Local Operating Assistance																					
Transfer from Project	YOE $M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
City Operating Subsidy	YOE $M	176	197	207	207	248	287	307	330	366	406	439	467	478	494	519	541	546	577	614	651
Total Local Assistance	**YOE $M**	**176**	**197**	**207**	**207**	**248**	**287**	**307**	**330**	**366**	**406**	**439**	**467**	**478**	**494**	**519**	**541**	**546**	**577**	**614**	**651**
Total Operating Revenues	**YOE $M**	**256**	**268**	**279**	**292**	**343**	**389**	**419**	**447**	**475**	**541**	**585**	**609**	**636**	**659**	**683**	**706**	**736**	**770**	**809**	**843**
Operations and Maintenance (O&M) Costs																					
TheBus O&M Costs	YOE $M	204	212	220	229	238	247	257	268	291	309	342	358	374	391	409	428	448	469	490	513
Rail O&M Costs	YOE $M	-	-	-	-	39	71	87	100	101	144	149	151	156	156	156	156	160	168	178	183
TheHandi-Van O&M Costs	YOE $M	52	55	58	61	65	68	72	76	80	85	89	94	99	104	109	114	120	126	132	138
Other O&M Costs	YOE $M	1	1	1	2	2	2	3	3	3	3	5	6	7	8	8	8	8	8	8	8
Total O&M Costs	**YOE $M**	**256**	**268**	**279**	**292**	**343**	**389**	**419**	**447**	**475**	**541**	**585**	**609**	**636**	**659**	**683**	**706**	**736**	**770**	**809**	**843**
Farebox Recovery (Bus and Rail)		**27%**	**27%**	**27%**	**32%**	**30%**	**28%**	**30%**	**28%**	**27%**	**27%**	**28%**	**27%**	**29%**	**29%**	**28%**	**28%**	**30%**	**29%**	**28%**	**27%**

Exhibit J-4: Operating Plan, Ridership Sensitivity, at Current Average Fare Rate

	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
Constant $'s											
No Reduction	$89,855,800	$100,325,001	$101,534,448	$102,743,895	$103,953,342	$105,162,789	$106,372,236	$107,581,683	$108,791,130	$110,000,577	$111,210,024
Total Revenue @ 95%	$85,363,010	$95,308,751	$96,457,725	$97,606,700	$98,755,675	$99,904,649	$101,053,624	$102,202,599	$103,351,574	$104,500,548	$105,649,523
Change from 100%	($4,492,790)	($5,016,250)	($5,076,722)	($5,137,195)	($5,197,667)	($5,258,139)	($5,318,612)	($5,379,084)	($5,439,557)	($5,500,029)	($5,560,501)
Total Revenue @ 90%	$80,870,220	$90,292,501	$91,381,003	$92,469,505	$93,558,008	$94,646,510	$95,735,012	$96,823,515	$97,912,017	$99,000,519	$100,089,022
Change from 100%	($8,985,580)	($10,032,500)	($10,153,445)	($10,274,389)	($10,395,334)	($10,516,279)	($10,637,224)	($10,758,168)	($10,879,113)	($11,000,058)	($11,121,002)
Total Revenue @ 85%	$76,377,430	$85,276,251	$86,304,281	$87,332,311	$88,360,341	$89,388,371	$90,416,401	$91,444,431	$92,472,461	$93,500,491	$94,528,521
Change from 100%	($13,478,370)	($15,048,750)	($15,230,167)	($15,411,584)	($15,593,001)	($15,774,418)	($15,955,835)	($16,137,252)	($16,318,670)	($16,500,087)	($16,681,504)